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OPTIMUM EJECTOR CHARACTERISTICS.(U)
JUN 81 R E SMITH, J W HOLTROP
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OPTIMUM EJECTOR CHARACTERISTICS

by

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JUNE 1981

NAVAL WEAPONS CENTER
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Naval Weapons Center
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FOREWORD

Previous analytical and experimental studies have shown that bomb rack ejection parameters, such as vertical velocity, pitch attitude, and pitch rate, can improve store separation motion. However, these investigations have generally evaluated a small number of specific stores and flight test conditions. New racks are being proposed which must be compatible with many different stores, aircraft, and flight test conditions. This study examined end-of-ejection requirements for this type of multipurpose rack and was accomplished during the period October 1977 to October 1980.

The majority of the effort, including initial planning, acquisition and organization of input data, and generation and analysis of the detailed trajectories, was supported by the Naval Air Systems Command (NAVAIR) and executed by the Naval Weapons Center (NWC) under the Strike Warfare Weaponry Technology Block Program under AirTask 03W-03P2/008B/0F32-300-000. This airtask provides for continued exploratory development in the air superiority and air-to-surface mission areas. E. M. Fisher, AIR-350, was the cognizant NAVAIR Technology Administrator.

Initial results from this effort were both timely and appropriate to the needs of the Advanced Aircraft Armament Systems (AAAS) study. The AAAS program then funded an expansion of the range of ejection parameters and an evaluation of acceptable separation envelopes for several specific stores. The AAAS program was funded under AirTask A350-350E-008C/1W0976-001, project element 63219N.

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(U) *Optimum Ejector Characteristics*, by R. E. Smith and J. W. Holtrop. China Lake, Calif., Naval Weapons Center, March 1981. 50 pp. (NWC TP 6274, publication UNCLASSIFIED.)

(U) Both the Navy and the Air Force are actively pursuing programs to standardize the aircraft-weapon interface. These programs include the development of general-purpose bomb racks that can be used on a wide variety of aircraft. Achieving successful aircraft-store separation from such a general-purpose rack requires the ejection forces to accommodate a wide variety of stores, aircraft, aircraft pylons, and aircraft flight conditions. Obviously, this is an extremely difficult task, especially with current bomb racks whose ejection forces change when aerodynamic loads are applied to the store. New bomb rack concepts have been ground-tested which demonstrate the ability to provide ejection forces that are relatively independent of the store aerodynamic loads. A computer study was conducted to identify the end-of-stroke ejection requirements for a general-purpose bomb rack with this independent capability.

CONTENTS

DEFINITIONS

C_M	Pitching moment coefficient, $\frac{M}{Qsd}$
C_N	Normal force coefficient, $\frac{N}{Qs}$
d	Store maximum diameter
EOE	End of Ejection
H	High
I	Moment of inertia (about store center of gravity)
L	Low
M	Medium or Pitch moment, ft-lb
N	Normal force, lb
Q	Dynamic pressure, $\frac{1}{2} \rho_A V^2$
S	Stable
s	Reference area, $\frac{\pi d^2}{4}$
U	Unstable
V	Velocity
W	Weight
Z	Vertical displacement (plus below captive location)
α	Store angle of attack (plus nose up)
θ	Store pitch attitude (plus nose up)
θ	Store pitch rate (plus nose up)
ρ	Store density parameter, $\frac{4W}{\pi l d^2}$
ρ_A	Air density

Subscripts

A/C	Aircraft
EJ	At end of ejection
I	In the aircraft influence flow field at Z = 0

INTRODUCTION

A great deal of effort has been spent on understanding, predicting, and solving weapon separation problems, but restrictions on weapon delivery envelopes still exist. Aerodynamic solutions to these problems are often limited by physical constraints imposed by aircraft fitment. In fact, as aircraft performance improves and low-drag weapon installations become more desirable, these physical constraints will be more severe. Improved bomb rack ejector characteristics could alleviate some of these problems.

Over the past 20 years, bomb racks have progressed in capability from a simple, nonejection concept to a single-ejector piston, and then to two independent ejectors. The next step in this progression is likely to be having the displacement of the two ejector pistons interdependent. State-of-the-art in-service racks use an orifice to control the force of each ejector and a common hot gas system to provide pressure to both pistons (Figure 1). By installing different sized forward and aft orifices, some control of store pitch motion can be achieved. This improvement in store separation motion requires anticipating, prior to flight, the aircraft delivery maneuvers and resulting store loads. Changes from these expected release conditions are not automatically controlled by the rack and, in some instances, may cause the ejector to degrade rather than improve the store separation motion. Mechanically or hydraulically connecting the two ejector pistons, Figure 2, can cause the ejector forces to compensate for aerodynamically induced store pitch motion. Rotation of the store will result in an increase in the ejector force opposing the motion and a decrease in the force aiding the rotation. The store end-of-ejection (EOE) pitch attitude and pitch rate can also be influenced by controlling the relative motion of the two ejectors. Figure 3 provides ground test data for a preliminary rack concept that illustrates this tendency to

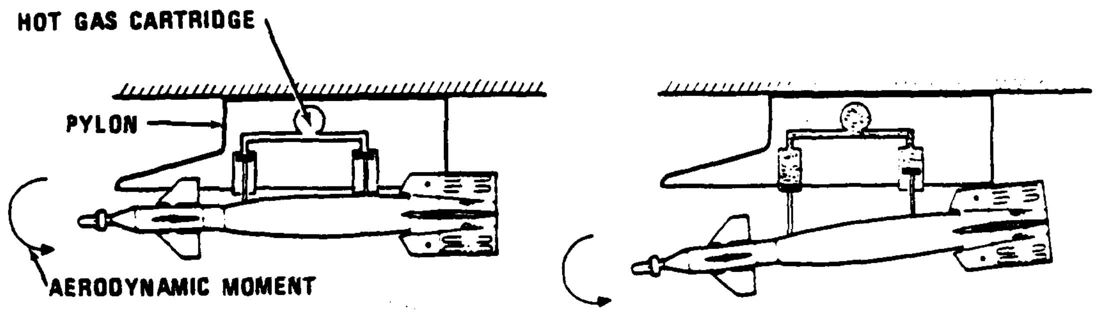


FIGURE 1. Conventional Store Ejectors.

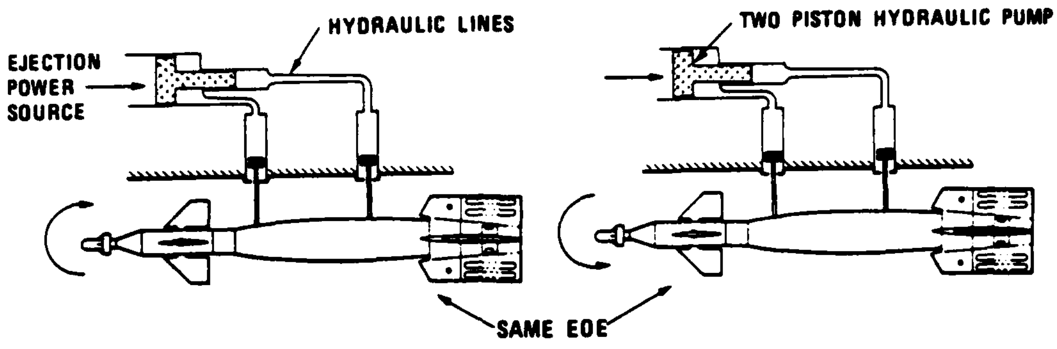


FIGURE 2. Dual Piston Dependent Concept.

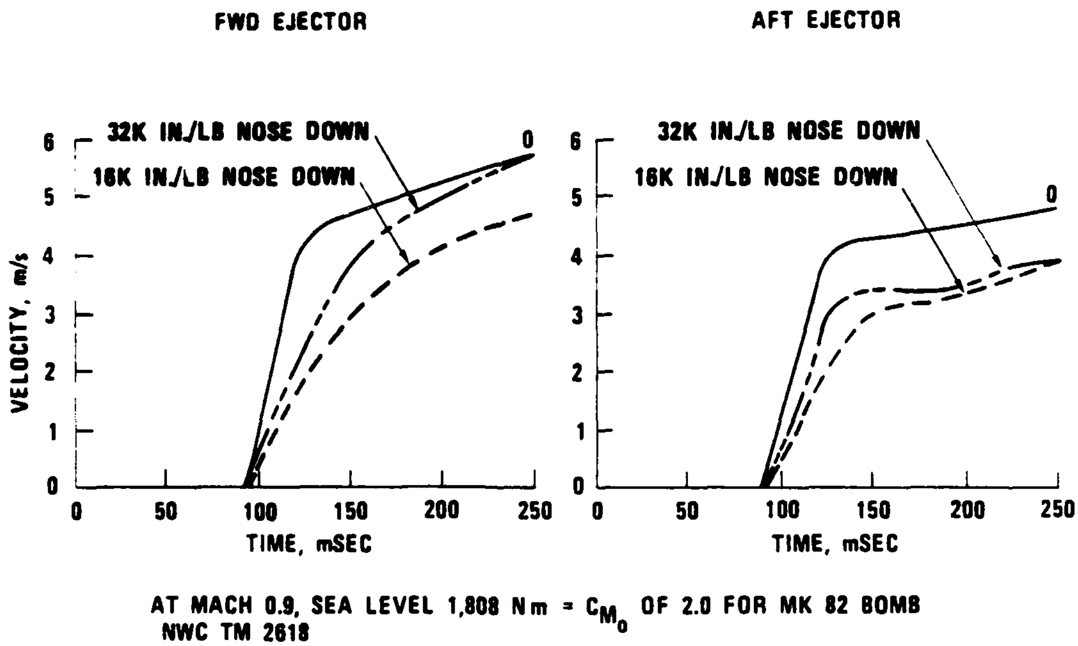


FIGURE 3. Effect of Store Aerodynamic Moments.

compensate for applied moments. The plots show the time history of the forward and aft bomb rack ejector pistons, and how these velocities change when large external moments are applied to the store during ejection. An Mk 82 store was used in the tests. The smaller of the two applied moments, 16,000 inch pounds, is representative of flight test data. Changes in store pitch motion are evident when the moments are applied, but these changes are small when compared with existing racks.

One of the objectives of the current Advanced Aircraft Armament System (AAAS) program is to standardize the physical interfaces between the aircraft, rack, and weapons. To accomplish this, a design specification is being written for a 14-inch and a 14/30-inch suspension rack that would be used on all aircraft. Designing one bomb rack with the capability of improving store separation motion for the wide variety of existing weapons, aircraft, and delivery conditions is a real challenge. To obtain optimum store trajectories, the ejector system must measure parameters related to the store aerodynamic loads and adjust the rack EOE characteristics accordingly. While improvements in bomb racks and stores management systems may make it possible to continuously adjust the rack to suit each specific set of store loads, the input data requirements, cost, and complexity of this system would be undesirably large. The intent of the work reported herein was to identify EOE combinations that would produce acceptable trajectories for a range of store loads, thus reducing the required ejector settings to an acceptable number, ideally one. Once it had been determined that a specific set of EOE conditions was acceptable for a range of store forces and moments, the rack had to deliver them relatively independently of any combination of store loads within that range. Three EOE parameters are used as inputs to the study: store pitch attitude, store pitch rate, and vertical velocity. The relative importance and required accuracy of each of these parameters are examined.

APPROACH

The effect of EOE parameters on store separation motion was investigated by calculating trajectories for a wide variety of different stores, aerodynamic loads, and EOE pitch attitudes, pitch rates, and vertical velocities. Prior to starting the calculations, a number of assumptions had to be made to simplify the problem to a manageable level, and a large amount of input data had to be acquired. First the calculations were limited to three-degree-of-freedom pitch plane trajectories. There are two reasons for this: it would be difficult to generalize the aircraft flow field in the yaw plane, and it is assumed new bomb racks will continue to control the ejection in the pitch plane only. Previous work[1] showed that in many instances store

[1] Naval Weapons Center. *Prediction of Store Separation Motion Using Initial Captive Loads*, by R. E. Smith. China Lake, Calif., NWC, October 1971. (NWC TP 5261, publication UNCLASSIFIED.)

separation motion can be reasonably predicted by using captive-carriage loads that linearly decay with vertical store displacement. This form of simple aircraft flow field representation was used in the study, with the loads reaching zero at a vertical distance of 10 feet below the initial store location.

It was not possible to include each of the hundreds of existing stores in the analysis, so the stores were divided into several categories and one store was chosen to represent each category. Store weight, static stability, and density are known to have a significant effect on separation motion and were used to establish the categories. Weight classes included 0 to 350 pounds, 351 to 750 pounds, 751 to 1250 pounds, and over 1251 pounds. Stores within the weight classes were subdivided into high-, medium-, or low-density groups and aerodynamically stable or unstable stores. Stability was judged on the average slope of the pitching moment curve over a range of ±10 degrees angle of attack. Density was approximated by the store weight divided by length and maximum cross-sectional area. High-, medium-, and low-density subgroups were established by examining the range of values for a large number of stores and arbitrarily assigning low density equal to 0 to 15; medium, 15 to 45; and high, >45 lb/ft^3. Twenty-four store categories were defined. An existing trajectory program[2] was used to calculate the three-degree-of-freedom trajectories because of its efficiency in calculating large numbers of separation trajectories. Input requirements for the program consisted of store free-stream aerodynamics and physical characteristics, aircraft flight parameters, ejector characteristics, store captive-carriage loads, and a representation of how the captive loads changed with store vertical displacement.

To ensure that the rack EOE parameters were getting a realistic test, it was necessary to acquire as large a cross section of aerodynamic loads as possible. Many references were examined to obtain wind tunnel and full-scale loads on as wide a majority of loads data were supplied by Arnold Engineering Development Center from their computer data bank of wind tunnel tests.[3] Loads were obtained for both primary and multiple bomb racks on the A-10, F-111, F-4, A-7, F-15, F-16, F-18, and F-105 aircraft. Mach numbers ranged from 0.3 to 1.60 and aircraft angles of attack from −6 to +20 degrees. Stores included conventional bombs, dispensers, fuel tanks, rocket pods, and guided munitions. Data from the 63 stores and eight aircraft were organized into plots of captive force versus captive moment for each category of store. Figure 4 shows a typical force-moment plot and Figure 5 illustrates the aircraft, stores, and flight conditions represented by Figure 4. The resulting force and moment envelopes were then represented in the study by three or four extreme points which represented the limits of the envelope (Figure 4). It is reasoned that a rack capable of providing acceptable store separation under these load conditions could, with proper adjustment of the ejector parameters, control any of the smaller load combinations. The stores

[2] Naval Weapons Center. *Fojt Six-Degree-of-Freedom Store Trajectory Program*, by Randy M. Rogers. China Lake, Calif., NWC, May 1978. (NWC TM 3485, publication UNCLASSIFIED.)

[3] Arnold Engineering Development Center. *Results of a Search for External-Store Carriage-Position Airloads To Assist a Navy Study of Ejector Requirements*, by G. R. Mattasits. Tullahoma, Tenn., AEDC, September 1978. (ARO, Inc, TMR-78-P5 and P6, publication UNCLASSIFIED.)

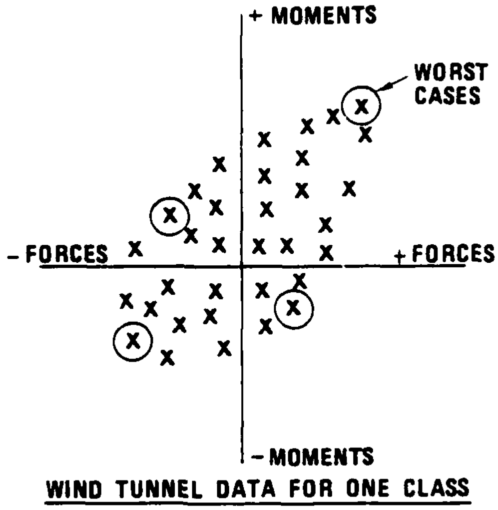


FIGURE 4. Typical Carriage Loads Data.

STORE WT	STATIC STABILITY	PYLON/MULT CARRIAGE	A/C	STORES	DENSITY	MACH
0 300 LB	UNSTABLE	PYLON	A-7	SUU-25 EMPTY	LOW	0.3 - 0.8
			A-7/F-4	BOFORS EMPTY	LOW	0.4 - 0.95
			A-7	CBU-30/38 EMPTY	LOW	0.3 - 0.8
			A-7	CBU-42 EMPTY	LOW	0.3 - 0.9
			A-7	LAU-3 EMPTY	LOW	0.4 - 0.75
			F-4/A-7	MATRA EMPTY	LOW	0.4 - 0.95
			A-7	300 GAL EMPTY	LOW	0.5 - 0.8
			F-18	315 GAL EMPTY	LOW	0.3 - 1.6
			F-4	370 GAL EMPTY	LOW	0.3 - 0.9
			F-105	LAU-68 EMPTY	LOW	0.4 - 0.9
			A-7	CBU-46 EMPTY	LOW	0.46

FIGURE 5. Sources of Carriage Loads Data for One Store Category.

and aircraft flight conditions that produced the selected loads were identified and used in the study whenever possible. Stores or captive loads did not exist for all of the 24 categories and, in some instances, the load envelope for a low-density category encompassed the corresponding medium-density envelope. In these instances, the low-density class was assumed to represent a more severe condition and the medium-density category was ignored. These considerations reduced the original 24 categories down to the 12 that were finally used in the study.

Free-stream normal force, pitching moment, and pitch damping were acquired for 14 representative stores. The actual stores used in the study and their physical characteristics are identified in Table 1. In two of the categories, trajectories were calculated for two different stores to provide a brief check on the validity of the parameters used to establish the categories. A trajectory was calculated for each combination of the EOE parameters shown in Table 2. The trajectory was started with the store possessing the specified EOE velocity, pitch attitude, and pitch rate. Termination of the trajectory occurred when the store center of gravity had moved 10 feet below the initial location or when the store angle of attack exceeded a specified plus or minus limit. The vertical store displacement, Z, at which the angular limits were exceeded became a figure of merit for ranking the capabilities of the different EOE combinations, with 10 being the best possible score. Several authors[4,5] have established safe separation limits in the past and each of these was considered; however, the selected limits were an arbitrary choice between the safe jettison criteria[4] and the minimum ballistic dispersion criteria.[5] Initially, ±10 degrees were selected, but it soon became apparent these were exceeded too often and too quickly to provide meaningful data. The negative limit was then changed to −30 degrees. The positive, pitch-up limit was left at 10 degrees because larger angles could result in normal forces sufficient to lift the store into the aircraft. These acceptability criteria are illustrated in Figure 6.

RESULTS

The study was conducted in three phases. First, a limited number of EOE parameters were used for a detailed investigation of the response of each store category. For the second part of the study, a much larger range of EOE values was evaluated.

[4] Naval Weapons Center. *Definition of Safe-Separation Criteria for External Stores and Pilot Capsules*, by Eugene E. Covert. China Lake, Calif., NWC, June 1971. (NWC TP 4995, publication UNCLASSIFIED.)

[5] Naval Surface Weapons Center. *Self Compensating Store Ejection*, by Raymond R. Maestri and L. H. Schindel. White Oak, Md., NSWC, February 1974. (NOLTR 74-32, publication UNCLASSIFIED.)

TABLE 1. Store Characteristics.

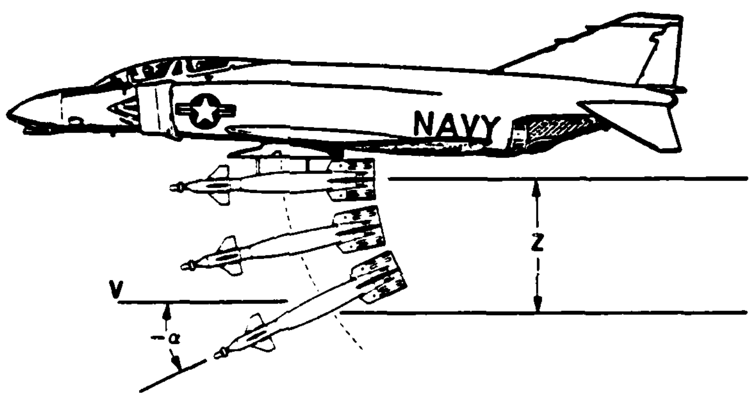
Store	Weight, lb	Stability	Density, lb/ft^3	Inertia, slug ft^2	Diameter, ft
A-10 450-gal tank (empty)	200	S	(L) 3.7	282	2.29
SUU-41	190	U	(L) 14.9	78	1.28
F-15 600-gal tank (empty)	330	U	(L) 2.6	250	2.72
SUU-42	383	S	(L) 11.6	75	1.89
M117	750	S	(H) 72.2	50	1.34
BLU-1 (unfinned)	725	U	(M) 35.8	162	1.56
Mk 20 (fins closed)	485	U	(H) 65.9	50	1.11
BLU-27 (finned)	820	S	(M) 37.1	162	1.54
SUU-30	820	S	(H) 76.9	60	1.34
BLU-27 (unfinned)	870	U	(M) 44.1	161	1.56
SUU-64	751	U	(H) 74.6	88	1.30
A-10 450-gal tank (full)	3129	S	(H) 57.4	4377	2.29
A-10 600-gal tank (full)	4480	U	(M) 37.9	3085	2.58
F-15 600-gal tank (full)	4280	U	(M) 34.0	2947	2.72

S = stable, U = unstable; L = low, H = high, M = medium.

TABLE 2. EOE Values.

Vertical velocity, ft/sec	15, 20, 25, 30
Pitch attitude, deg	−8, −6, −4, −2, −1, 0, 2, 4, 8
Pitch rate, rad/sec	−4, −3, −2, −1, 0, 2, 4

Trajectory results were examined in terms of how successfully specific values of EOE store velocity, pitch attitude, and pitch rate could separate all of the stores. The final phase briefly analyzed the range of carriage loads for which a specific set of EOE values could provide acceptable separation. Acceptable separation was again defined as the store falling 10 feet below the carriage location without exceeding +10 or -30 degrees angle of attack. Study results are usually presented for store normal force (C_{N_I}) and pitching moment (C_{M_I}) influence coefficients, which represent the total captive load measured in the wind tunnel. If actual forces and moments used in the study are desired, they can be calculated from the influence coefficients by assuming a release altitude of 5000 feet MSL and using the aircraft velocities provided in Table 3. Reference dimensions are based on the store diameters shown in Table 1.



● TRAJECTORY COMPARISONS ARE BASED ON VERTICAL DISTANCE (Z) REACHED WHEN STORE ANGLE OF ATTACK (α) EXCEEDS +10° OR -30°

FIGURE 6. Acceptability Criteria.

PHASE I

Because of the large number of trajectories computed, detailed data on each trajectory are not included in this report. Instead, data are presented in terms of the vertical distance (Z) the store traveled before it reached the positive or negative pitch angle limit. If the store did not reach an angle limit, the trajectory is represented by a vertical distance of 10 feet and the maximum angle of attack the store did reach, i.e., 10/18 degrees. For the EOE conditions, the store pitch attitudes (θ) were input as negative (nose down) values, while the pitch rate ($\dot{\theta}$) was opposite in sign to the pitching moment influence coefficient (C_{M_I}).

TABLE 3. Detailed Trajectory Results (Z for α = +10 or −30 Degrees).

A plus sign (+) indicates the store exceeded the +10 degree pitch limit. The absence of a plus sign signifies the −30 degree limit was reached. An asterisk (*) represents a condition where the store lift force was sufficient to move the store center of gravity up.

Store	θ $\lvert\dot{\theta}\rvert$ V_{EJ}	0 0 25	−2 0 25	−5 0 25	0 0 20	−2 0 20	−5 0 20	0 0 15	−2 0 15	−5 0 15	0 0 10	−2 0 10	−5 0 10	−2 .1 15	−2 .25 15	−2 .5 15	−2 2.0 15	−5 .1 15	−5 .25 15	−5 .5 15	−5 2.0 15	C_{N_1}	C_{M_1}	$V_{A/C}$
SUU-41 Unstable	Z	3.44	3.31	3.14	2.48	2.40	2.40	1.40	1.50	1.60	.50	.70	.90	1.50	1.50	1.50	*	1.60	1.70	1.70	1.30	1.1	−2.26	757
W = 190#	Z	8.80	7.30	5.80	7.50	6.30	5.00	6.30	5.30	4.30	5.20	4.40	3.60	5.50	5.80	6.40	3.80+	4.40	4.60	5.00	10/−21°	−.67	−1.1	998
ρ = LOW	Z	5.00+	9.70+	8.20	4.20+	10/+2°	6.70	3.40+	10/−25°	5.40	2.60+	6.90	4.00	8.20	6.80	5.60	3.00	5.00	4.80	4.30	2.50	.086	.117	866
I = 78 slug ft^2	Z	2.40	2.30	2.30	1.70	1.80	1.80	1.10	1.20	1.30	.50	.60	.75	1.10	1.10	1.20	.90	1.30	1.20	1.20	1.20	.83	−2.79	998
600-Gal Tank (F-15)	Z	1.90+	3.60	2.70	1.40+	2.80	2.30	*	2.20	1.70	.60	1.60	1.30	2.10	2.20	2.10	2.20	1.70	1.70	1.80	2.00	248	−.37	976
Unstable	Z	1.80+	3.70+	4.50	1.60+	3.70+	3.80	1.30+	3.80+	3.00	1.00+	7.40	2.50	4.10+	4.70+	7.50+	4.90	3.10	3.00	2.90	2.60	−066	90	965
W = 330#	Z	2.10+	3.20+	7.30	1.80+	2.90+	5.70	1.40+	2.50+	4.40	1.00+	2.00+	3.30	2.50+	2.60+	2.90+	8.30	4.20	4.30	4.00	3.30	10	1.50	658
ρ = LOW, I = 250 slug ft^2	Z	1.90+	3.50	2.70	1.50+	2.90	2.20	*	2.30	1.80	1.40	1.70	1.40	2.30	2.20	2.30	2.50	1.70	2.0	1.90	2.20	176	−41	1097
SUU-42 Stable	Z				10/−4°	10/−3°	10/−2°	10/−4°	10/−3°	10/−3°	10/−4°	10/−3°	10/−3°	10/−2°	10/−2°	10/−3°	10/+10°	10/−3°	10/−3°	10/−3°	10/+10°	1.11	−23	344
W = 383#	Z				10/−8°	10/−6°	10/−5°	10/−8°	10/−6°	10/−5°	10/−8°	10/−6°	10/−5°	10/−6°	10/−6°	10/−6°	10/−7°	10/−4°	10/−4°	10/−4°	10/−6°	−.025	−63	1042
ρ = LOW, I = 75 slug ft^2	Z				10/−13°	10/−12°	10/−10°	10/−14°	10/−13°	10/,10	10/−14°	10/−13°	10/−11°	10/−12°	10/−12°	10/−12°	10/−13°	10/−10°	10/−10°	10/−10°	10/−11	.39	−1.06	822
M-117	Z				10/−21°	10/−20°	10/−18°	10/−22°	10/−21°	10/−18°	10/−23°	10/−21°	10/−19°	10/−21°	10/−21°	10/−21°	10/−21°	10/−18°	10/−18°	10/−18°	10/−19°	85	−1.80	763
Stable	Z				10/8°	10/9°	5.80+	10/9°	10/10°	4.60+	10/9°	10/10°	3.50+	10/9°	10/9°	10/9°	9.10+	4.80+	5.30+	5.80+	6.90+	−1.33	55	768
W = 750#	Z				2.60	9.30+	9.60+	2.10	2.50	9.30+	1.50	1.90	8.70+	2.40	2.60	2.60	2.80	9.00+	9.20+	9.10+	9.20+	23	−2.31	1316
ρ = HIGH	Z				1.3+	1.4+	1.5+	.9+	1.0+	1.1+	.6+	.7+	.8+	1.0+	1.1+	1.1+	1.4+	1.1+	1.2+	1.2+	1.5+	1.27	3.04	823
I = 50 slug ft^2	Z				8.0	7.9	8.0	6.2	6.3	6.2	4.8	4.6	4.6	6.4	6.8	7.5	10/−20.4	6.4	7.0	7.7	10/−17.5	−.85	−3.93	329
BLU-1 Unfin Unstable	Z				10/−7°	10/−19°	8.80	10/−21	8.60	6.60	7.60	5.90	4.70	9.60	10/−18°	10/5°	1.80+	7.00	8.10	10/−25°	2.50+	48	−68	548
W = 725#	Z				5.30+	6.50+	9.10+	4.60+	5.50+	7.80+	3.70+	4.60+	6.50+	6.30+	8.10+	10/6°	5.60	9.00+	10/7°	10/4°	4.70	−1.62	1.83	329
ρ = MED, I = 162 slug ft^2	Z				4.30	4.00	3.50	3.40	3.00	2.80	2.30	2.10	1.90	3.20	3.20	3.40	5.60	2.80	2.90	3.00	4.60	16	−2.32	823
SUU-42	Z				10/−4.5+	10/−3.3	10/−.7	10/−4.5	10/−3.3	10/−.7	10/−4.5	10/−3.2	10/−9	10/−3.2	10/−3.2	10/−3.3	10/−4.8	10/−9	10/−1.0	10/−1.3	10/−3.9	−46	−36	987
(SEE ABOVE)	Z				1.29*	1.71*	2.45*	.83*	1.20*	1.86*	.45	.72*	1.32*	1.25*	1.32*	1.45*	2.71*	1.92*	2.02*	2.19*	3.59*	32	47	987
	Z				10/1.6	10/2.6	10/4.2	10/1.8	10/2.9	10/4.5	10/2.1	10/3.1	10/4.7	10/2.8	10/2.8	10/2.8	10/3.5	10/4.4	10/4.4	10/4.3	10/4.6	−36	19	987
Mk 20 Unstable	Z				7.40	7.20	6.60	5.50	5.20	5.0	3.70	3.70	3.40	5.70	5.80	6.40	10/−18°	5.20	5.60	6.00	10/−20°	1.08	−1.35	658
W = 485#	Z				10/−19°	10/−22°	10/−26°	10/−26°	9.60	8.60	8.20	7.70	6.90	10/−27°	10/−24°	10/−19°	3.00+	9.20	9.90	10/−23°	10/9°	−1.51	−1.01	713
ρ = HIGH	Z				6.30+	7.80+	10/10°	5.40+	6.60+	8.50+	4.30+	5.20+	6.60+	7.70+	9.90+	10/4°	7.10	10/10°	10/7°	10/−4°	5.80	−1.21	1.43	329
I = slug ft^2	Z				3.70	3.60	3.40	2.90	2.70	2.60	2.10	2.00	1.90	2.90	2.90	3.10	3.90	2.80	2.80	3.00	3.80	17	−3.33	823

TABLE 3. (Contd.)

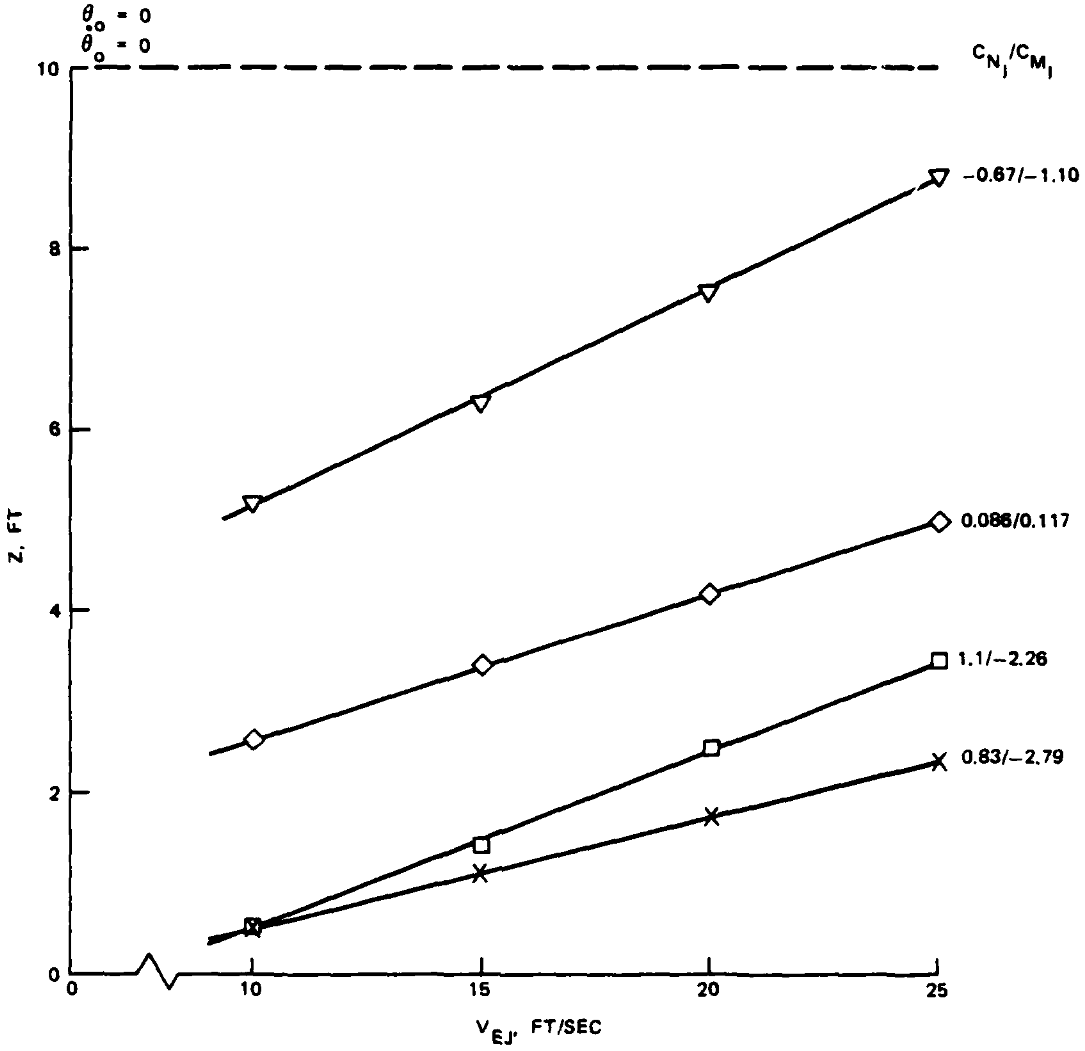
Store	θ $\dot{\theta}$ t	0 0 25	-2 0 25	-5 0 25	0 0 20	-2 0 20	-5 0 20	0 0 15	-2 0 15	-5 0 15	0 0 10	-2 0 10	-5 0 10
BLU-27 Fin Stable W = 820# ρ = MED I = 162 slug ft²	Z Z Z Z				10/-22 10/8 6.50* 7.30	10/-22 10/6 7.50* 7.30	10/-21 10/3 10/16 7.20	10/-26 10/9 5.30* 5.60	10/-26 10/7 6.20* 5.60	10/-24 10/4 7.90* 5.60	6.70 10/10 4.20* 4.10	[illegible] 10/8 5.00* 4.00	10/-25 10/5 6.00* 4.20
SUU-30 Stable W = 92?# ρ = HIGH I = 60 slug ft²	Z Z Z				4.80 9.00* 3.40	5.00 10/7 3.50	5.40 10/8 3.40	3.60 10/9 2.70	3.90 10/8 2.70	4.00 10/10 2.80	2.60 7.50* 1.90	2.60 7.50* 2.00	2.90 6.80* 2.10
BLU-27 Unfin Unstable W = 870# ρ = MED I = 161 slug ft²	Z Z Z Z				10/3 3.70 3.90* 4.80	10/-3 4.90 5.30* 4.20	10/-11 4.00 9.00* 3.70	10/2 4.60 3.20* 3.70	10/-8 3.90 4.20* 3.40	10/-19 3.30 7.60* 3.00	10/-8 3.50 2.50* 2.70	10/-19 3.00 3.50* 2.60	8.50 2.40 6.00* 2.20
SUU-64 Unstable W = 751# ρ = HIGH I = 86 slug ft²	Z Z Z Z				5.10 9.20 3.20* 4.70	5.10 10/5 3.80* 4.60	4.70 10/-4 5.00* 4.20	3.90 8.00 2.50* 3.60	3.70 10/6 3.00* 3.50	3.50 10/-4 4.00* 3.40	2.50 6.90* 1.90* 2.60	2.50 10/8 2.30* 2.60	2.50 10/-5 3.00* 2.40
600-Gal Tank (A-10) Unstable W = 4480# ρ = MED I = 3085 slug ft²	Z Z Z Z				10/-4 5.40* 7.30* 3.30	10/-16 10/8 10/10 7.50	9.60 10/2 10/4 6.00	10/-14 7.90* 6.50* 6.60	9.70 10/8 9.40* 5.50	7.30 10/-2 10/3 4.60	8.70 7.40* 5.90* 4.40	6.60 10/8 8.30* 3.70	5.20 10/-3 10/3 3.20
600-Gal Tank (F-15) Unstable W = 4280# ρ = MED I = 2947 slug ft²	Z Z Z Z							5.60* 5.10* 5.40* 5.70	6.40 7.30 8.80* 6.20	4.30 4.60 10/-9 4.20	5.50* 4.50* 4.50 6.10*	4.50 5.20 8.20 4.50	3.10 3.40 10/-19 3.00
A-10 450-Gal (I) Stable W = 200# ρ = LOW I = 282 slug ft²	Z Z Z	10/-1.5 10/-2.7 10/-4.9	10/2 10/-2.1 10/-3.8	10/2.3 10/1.3 10/-7	10/-1.0 10/-2.6 10/-4.8	10/9 10/-1.9 10/-3.7	10/3.0 10/1.5 10/-2.4	10/.7 10/-2.5 2.6*	10/1.7 10/-1.8 2.7*	10/3.6 10/1.8 3.8*	10/.7 10/-2.4 25*	10/-8 10/-1.7 1.0*	10/-2.5 10/1.9 1.7*
A-10 450-Gal (O) Stable W = 3129# ρ = MED I = 4377 slug ft²	Z Z Z Z							10/-21.2 10/5.4 10/7.7 10/5.9	10/-20.2 10/4.7 10/6.3 10/4.6	10/-18.2 10/3.6 10/3.9 10/2.2	10/-26.4 10/6.2 10/8.6 10/6.4	10/-24.7 10/5.7 10/7.2 10/5.1	10/-21.9 10/5.0 10/5.1 10/3.1

Store	-2 1 15	-2 25 15	-2 5 15	-2 2.0 15	-5 1 15	-5 25 15	-5 5 15	-5 2.0 15	C_{N_1}	C_{M_1}	$V_{A/C}$
BLU-27 Fin	10/-25 10/-3 7.20* 5.70	10/-24 10/1 9.00* [illegible]	10/-23 10/-5 10/5 6.50	2.30* 6.40 10/-23 10/-26	10/-23 10/-3 9.10* 5.80	10/-23 10/-3 10/8 6.20	10/-21 10/-7 10/-4 6.60	10/9 5.60 10/-24 10/-24	51 -68 -59 37	-1.29 43 1.43 -2.30	658 384 384 658
SUU-30	3.90 9.00* 2.70	4.10 10/6 2.70	4.00 10/4 2.90	4.80 10/-15 3.20	4.20 10/9 2.80	4.20 10/8 2.80	4.40 10/5 3.00	5.50 10/-17 3.60	66 -1.94 26	-2.25 95 -3.06	713 329 823
BLU-27 Unfin	10/-3 4.00 4.80* 3.50	10/4 4.30 5.80* 3.60	6.80* 4.70 10/10 3.80	1.40* 3.70* 4.40 9.00	10/-15 3.40 10/10 2.90	10/-8 3.60 10/-8 3.00	10/5 3.80 9.80 3.30	1.80* 8.30 3.50 5.50	60 -47 17 -25	-68 -1.00 76 -1.46	384 1042 658 987
SUU-64	3.90 10/3 3.20* 3.60	4.00 10/-2 3.50* 3.70	4.30 10/-9 4.10* 3.90	5.10 6.40 10/-20 5.20	3.70 10/-7 4.20* 3.50	3.90 10/-12 4.70* 3.60	4.00 10/-20 5.70* 3.80	5.60 5.40 10/-26 5.20	77 -87 -045 38	-94 10 68 -1.33	1042 1042 1042 1042
600-Gal Tank (A-10)	10/-24 10/5 10/8 5.90	10/-14 10/0 10/3 6.30	10/6 10/-9 10/-6 7.60	1.50* 5.00 5.20 2.00*	7.70 10/-3 10/-2 4.70	8.70 10/-8 10/-5 5.10	10/-22 10/-16 10/-13 5.70	2.20* 4.30 4.30 3.00*	1.31 -1.60 -1.15 1.28	-2.69 98 2.52 -3.49	548 329 329 713
600-Gal Tank (F-15)	6.80 8.10 10/9 6.70	7.90 10/-29 10/2 7.80	10/4 7.10* 10/-10 10/-3	1.80* 1.80* 5.20 1.90*	4.40 4.70 10/-13 4.40	4.60 5.00 10/-19 4.60	5.06 5.60 10/-30 5.10	3.60* 3.40* 4.06 3.60*	24 -03 01 24	-41 -19 1.39 -46	965 965 472 965
A-10 450-Gal (I)	10/1.7 10/-1.9 2.3*	10/2.0 10/-2.1 1.8*	10/2.1 10/0.8 6*	10/-12.9 10/-4.8 4*	10/3.5 10/1.8 2.4	10/3.7 10/2.0 1.9	10/-4.0 10/2.3 1.1	10/-13.2 10/5.2 5	43 -21 35	18 -2 -5	362 998 998
A-10 450-Gal (O)	10/-19.2 10/3.0 10/3.9 10/2.1	10/-17.9 10/-1.2 [illegible] 10/-1.6	10/-15.3 10/-3.5 10/-5.2 10/-7.5	2.0* 10/-23.8 5.8* 5.3*	10/-17.1 10/2.0 10/1.6 10/-2.4	10/-15.6 10/-4.0 10/-2.9 10/-3.9	10/-13.3 10/-5.5 10/-7.4 10/-9.6	2.6* 10/-24.5 5.0* 4.8*	1.73 -2.23 -1.5 1.13	-5.03 1.16 3.63 1.87	713 713 329 329

Results for each trajectory are shown in Table 3, with the left-hand column providing information on the stores used, the right-hand columns showing the influence coefficients and aircraft velocity, and the top three rows indicating the EOE conditions. The "Z" values are shown for each computed trajectory. A plus sign (+) by the Z value indicates the store exceeded the +10 degree pitch limit, while the absence of a plus sign signifies the -30 degree limit was reached. The asterisk represents a condition where the store lift force was sufficient to move the store center of gravity up. Although the quantity of numbers shown is somewhat imposing, the interpretation of the data is straightforward. The larger the number shown, the better the EOE conditions were able to compensate for the initial air loads. As might be expected, in some instances the initial loads completely overpower the assumed ejector capability, for example, the SUU-41 and empty 600-gallon F-15 fuel tank. Generally there is at least one set of EOE conditions that produces "acceptable" results. It is evident from the results shown that the sign and magnitude of both the normal force and pitching moment influence coefficients can have a significant effect on the results.

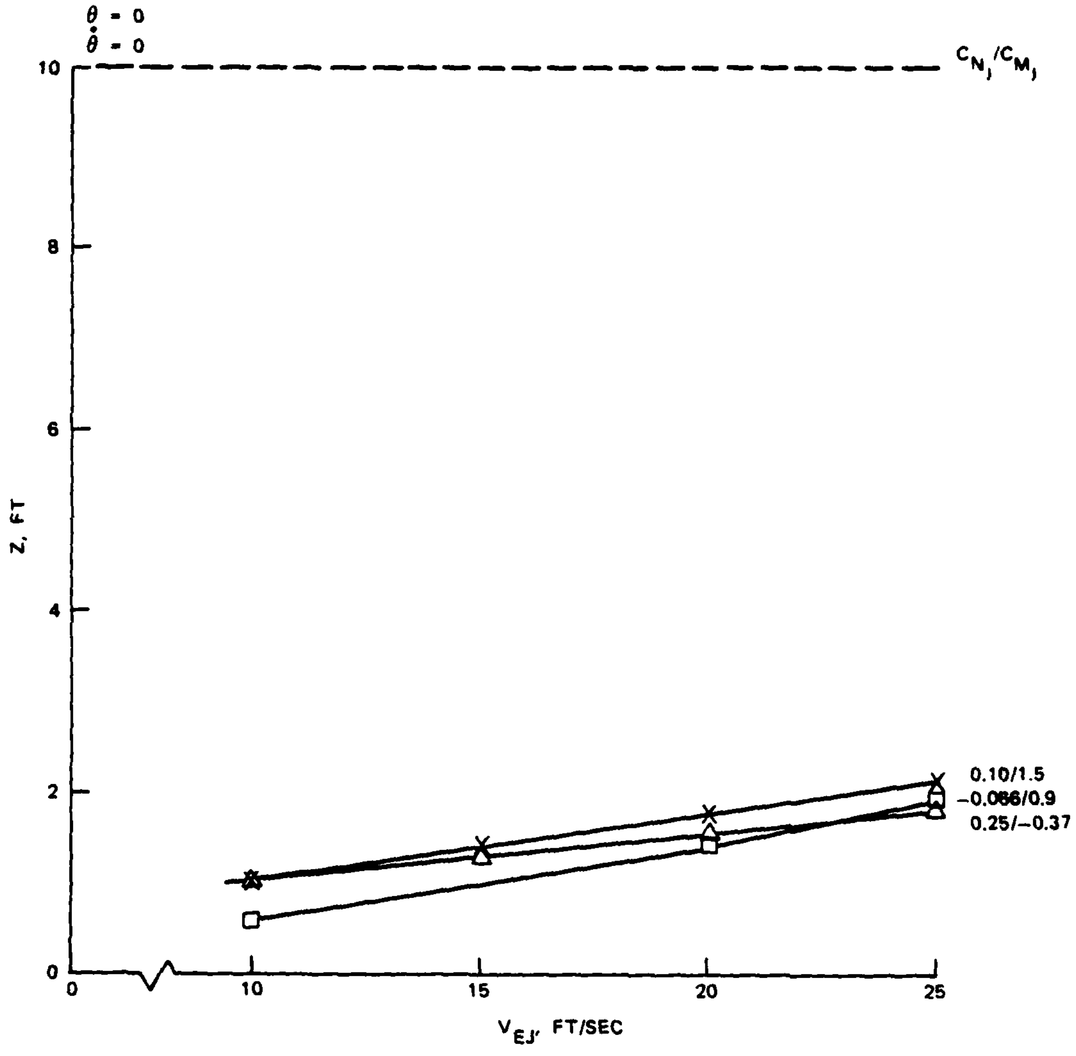
Sensitivity of the computer trajectories to changes in EOE vertical velocity is shown in Figures 7a through 7l, and sensitivity to pitch rate and store attitude in Figures 8a through 8k. In most cases, increasing the vertical ejection velocity improves separation, but extremely high values would be required for some store-load combinations. If a store separates safely at a lower ejection velocity, increasing the velocity will generally not degrade the separation motion. An exception to this can be found in Figure 7h for the SUU-30 weapon. Pitch rate produced very mixed results. The SUU-30 and the empty 600-gallon F-15 fuel tank had several cases that were virtually unaffected by pitch rates as high as 2 rad/sec, while the BLU-27 is sometimes helped and sometimes hurt by increasing EOE pitch rate.

None of the above results are particularly startling or even unexpected, but they do illustrate the complexities involved in designing a "smart" ejection system that would make an inflight selection of appropriate EOE conditions.



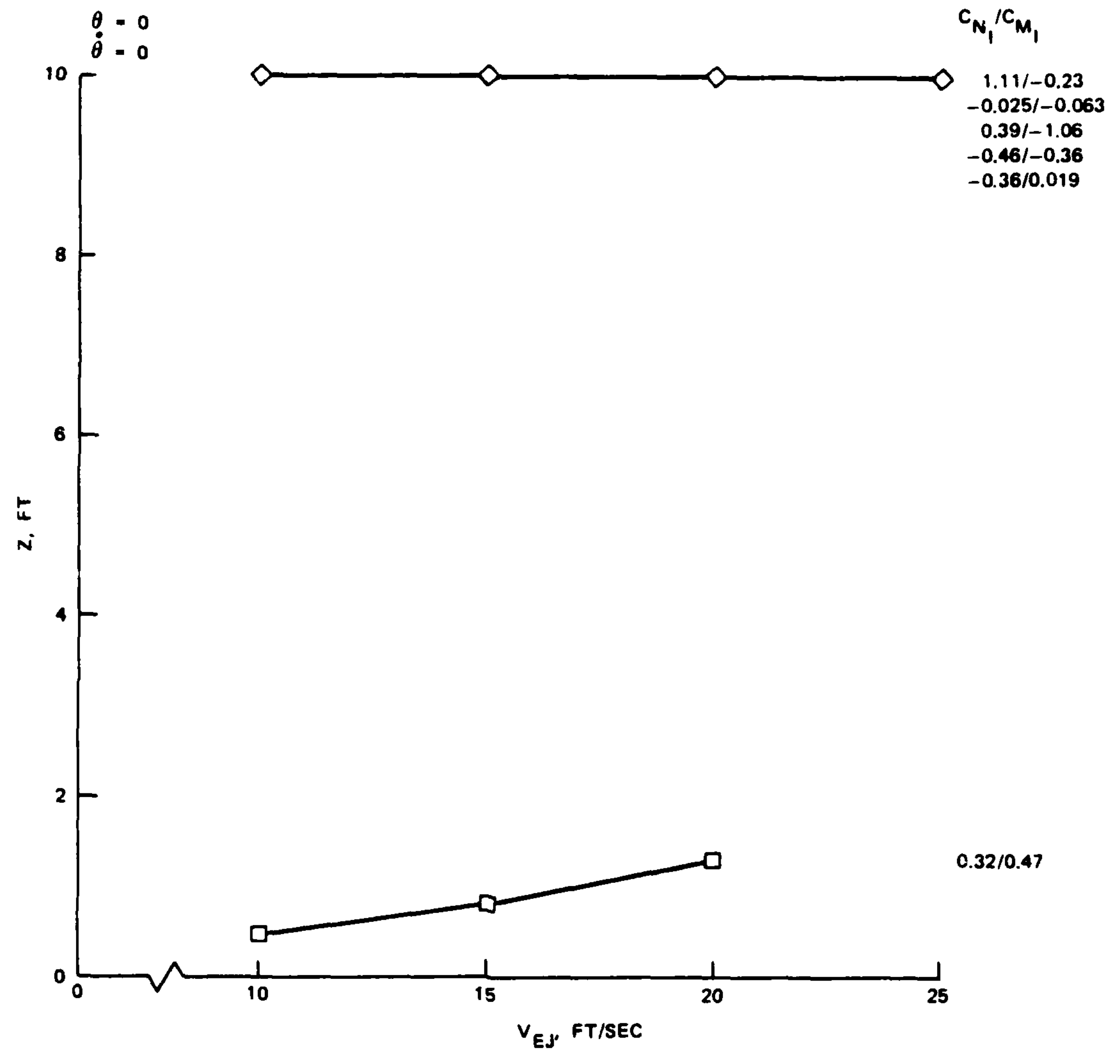
(a) SUU-41 (unstable).

FIGURE 7. Effect of Ejection Velocity on Individual Stores.



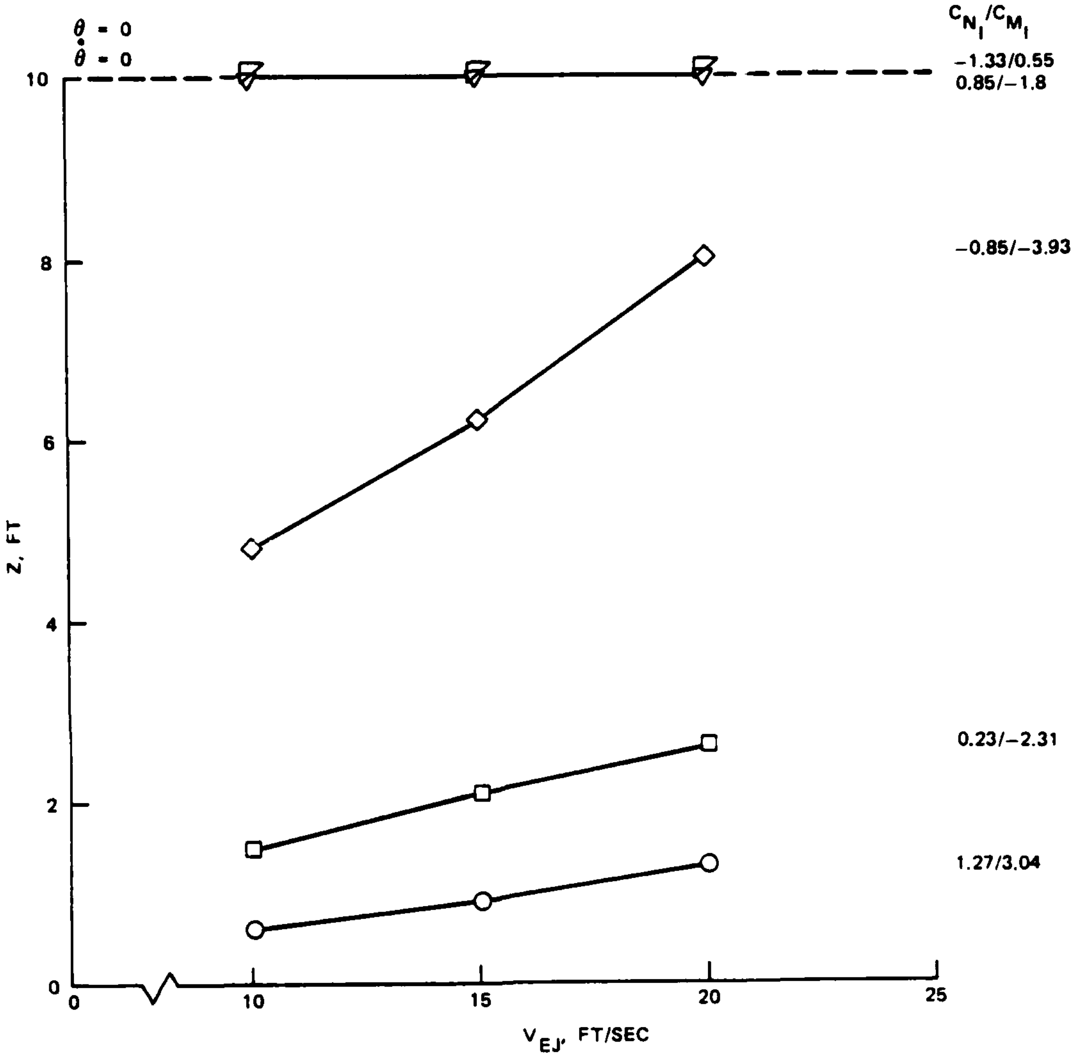
(b) F-15 600-gallon fuel tank (empty)(unstable).

FIGURE 7. (Contd.)



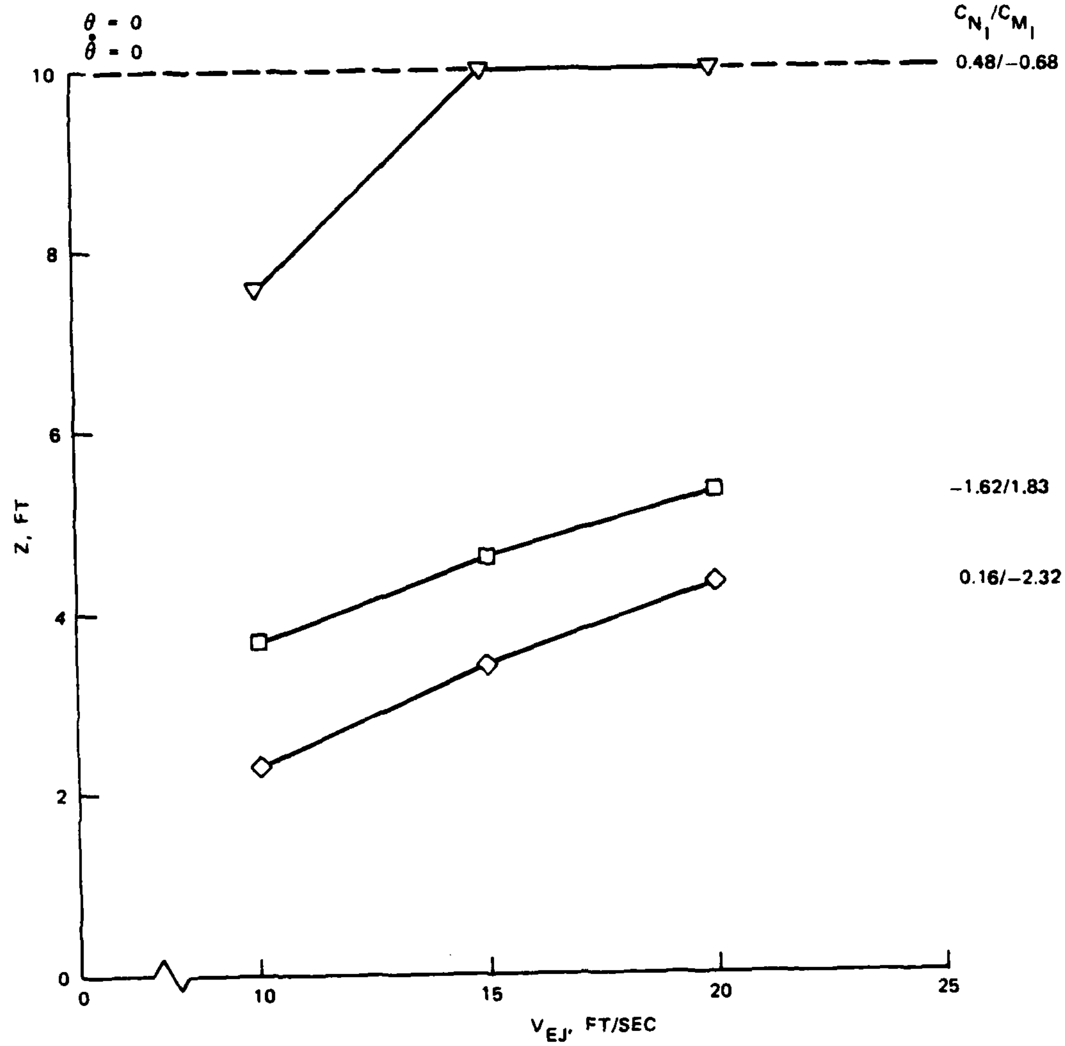
(c) SUU-42 (stable).

FIGURE 7. (Contd.)



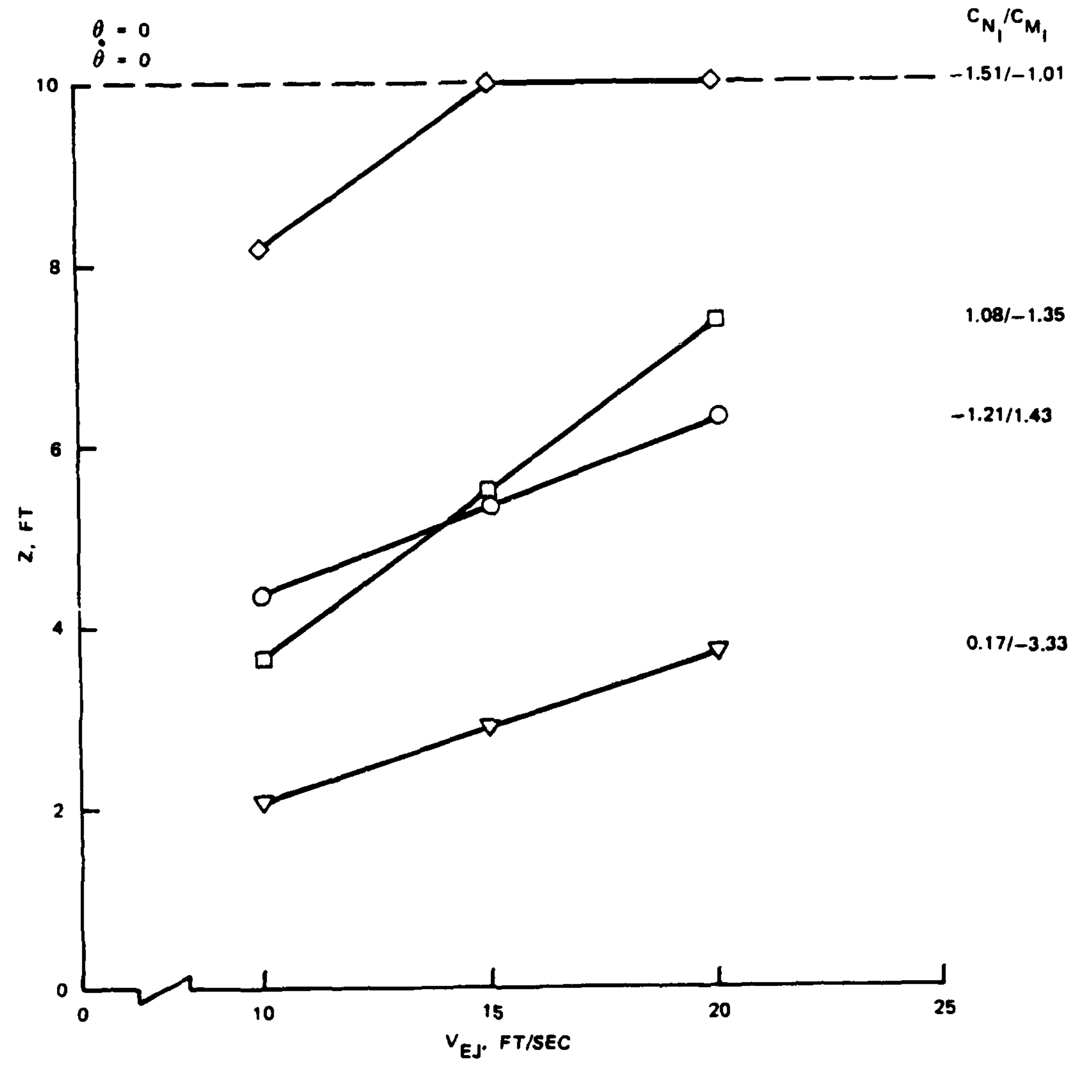
(d) M-117 (stable).

FIGURE 7. (Contd.)



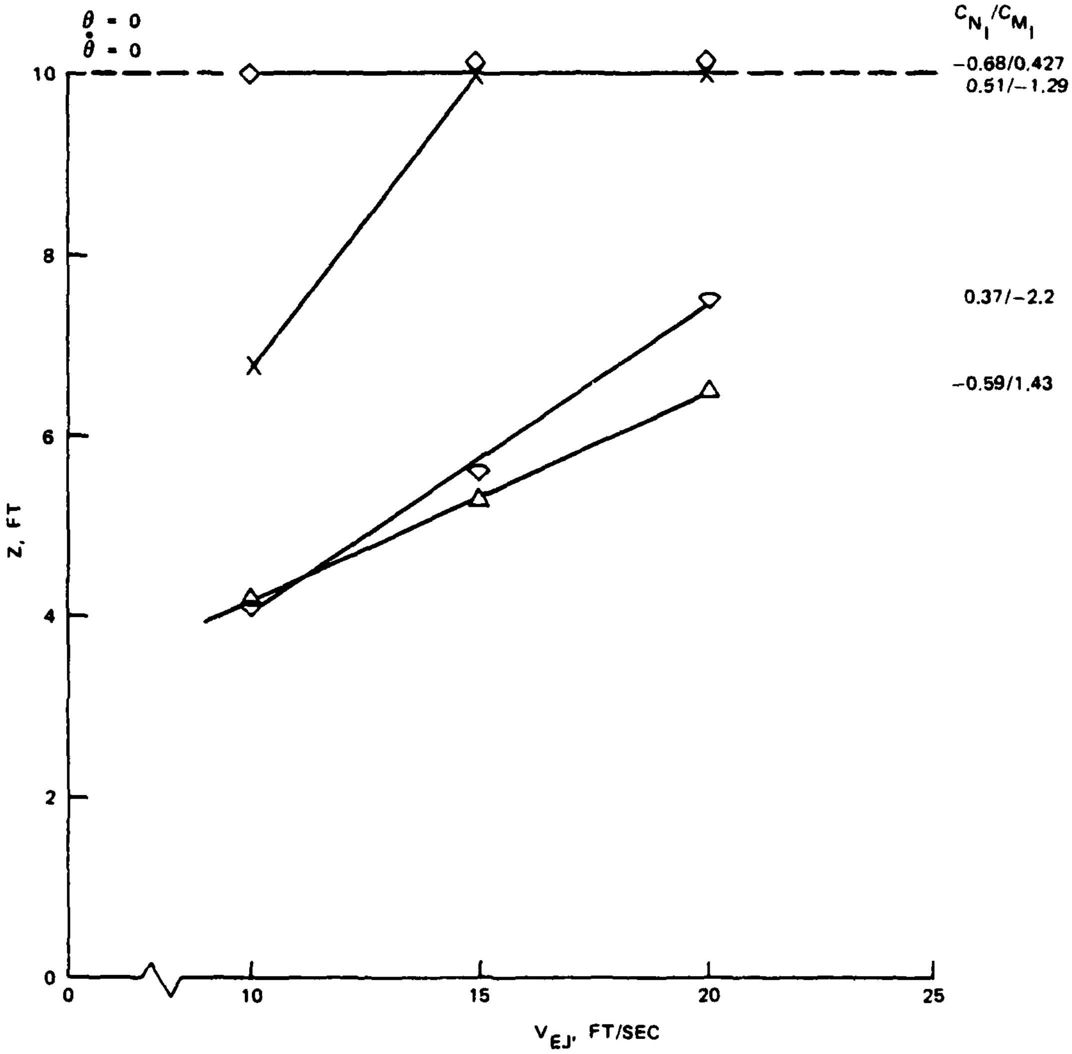
(e) BLU-1 (unstable).

FIGURE 7. (Contd.)



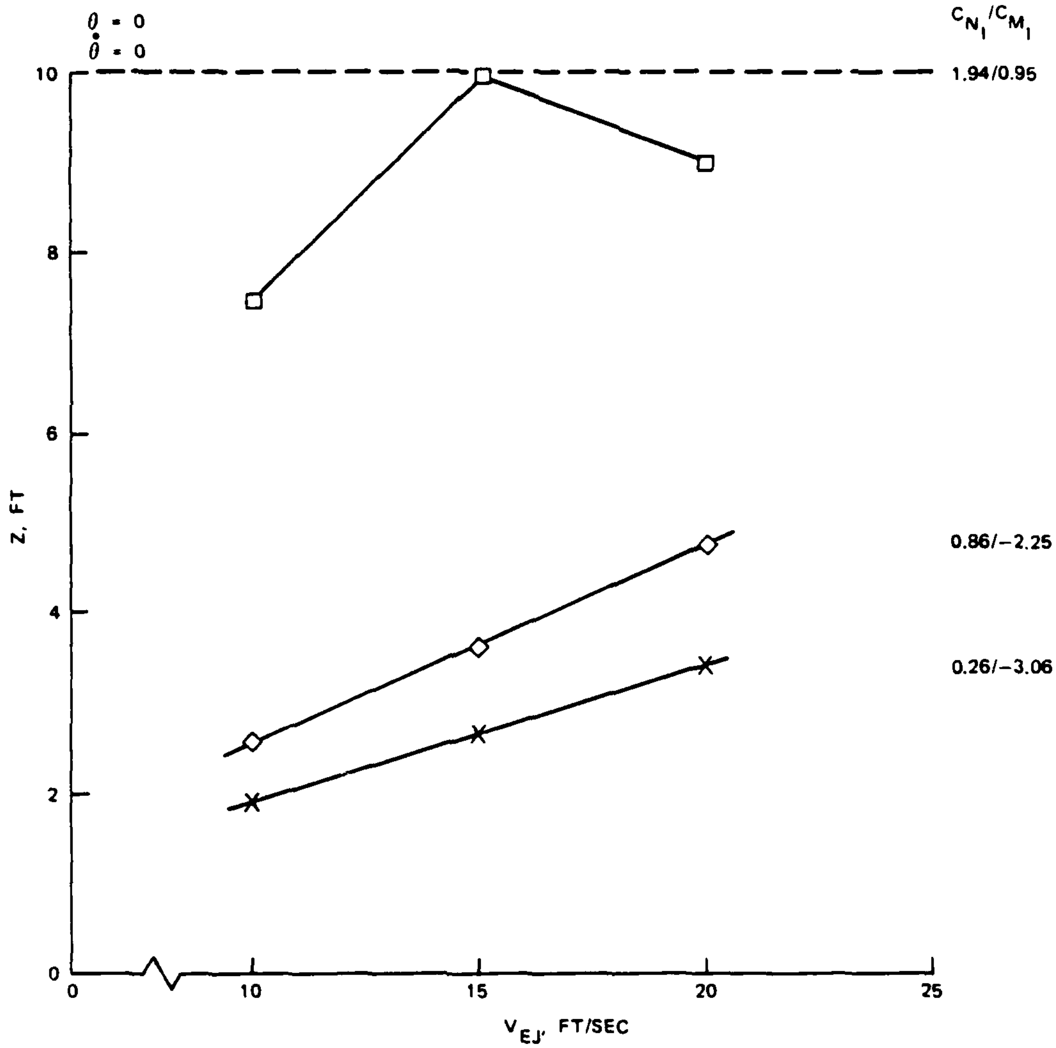
(f) Mk 20 (unstable).

FIGURE 7. (Contd.)



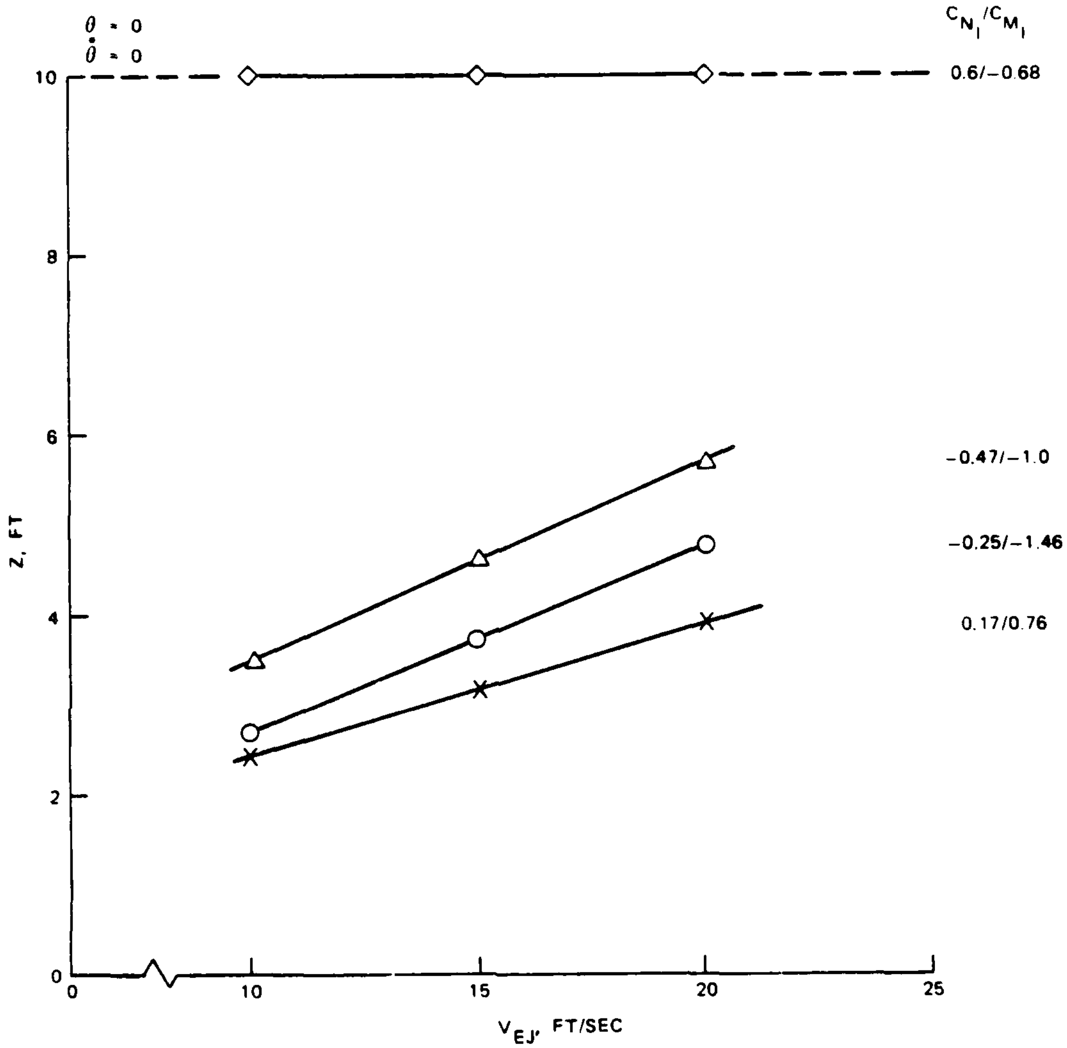
(g) BLU-27 (stable).

FIGURE 7. (Contd.)



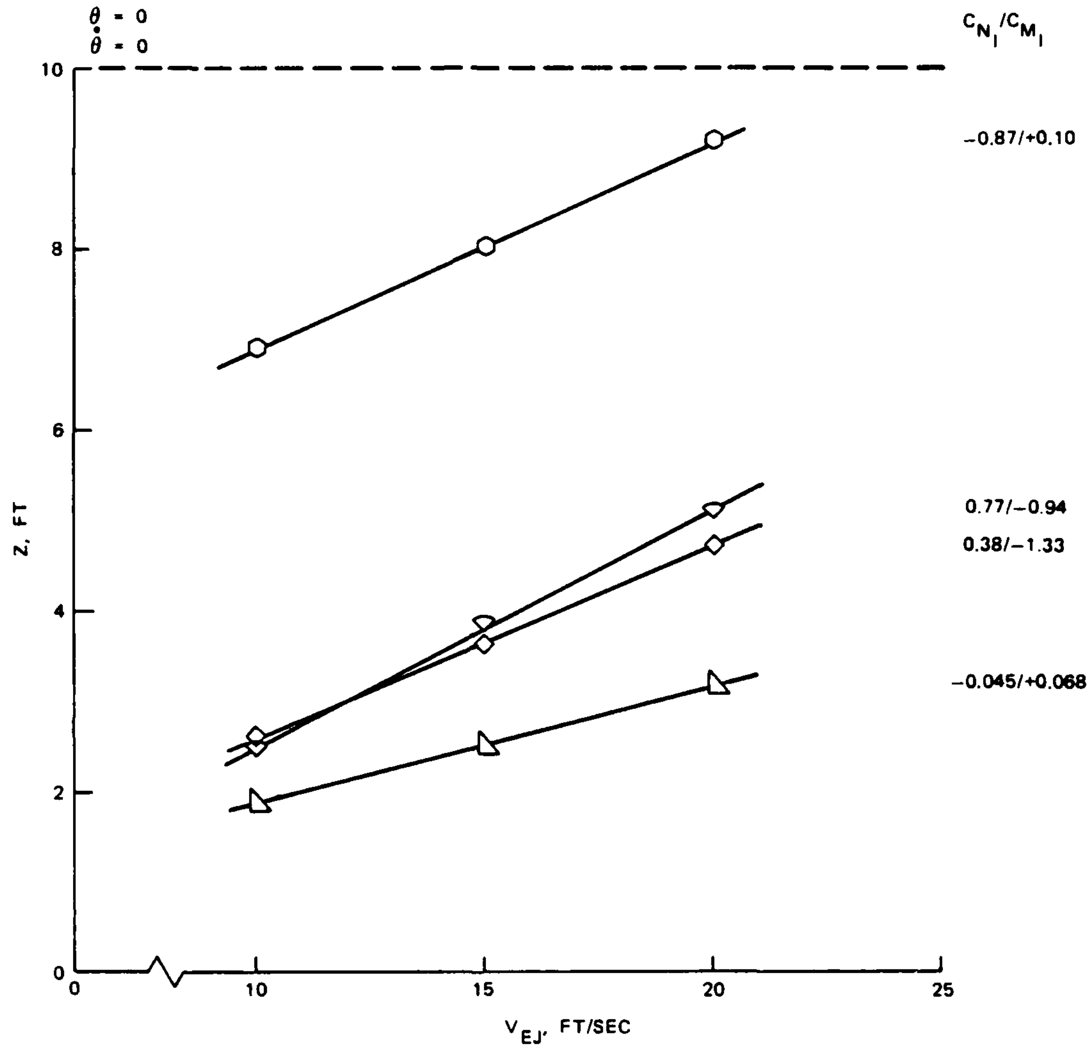
(h) SUU-30 (stable).

FIGURE 7. (Contd.)



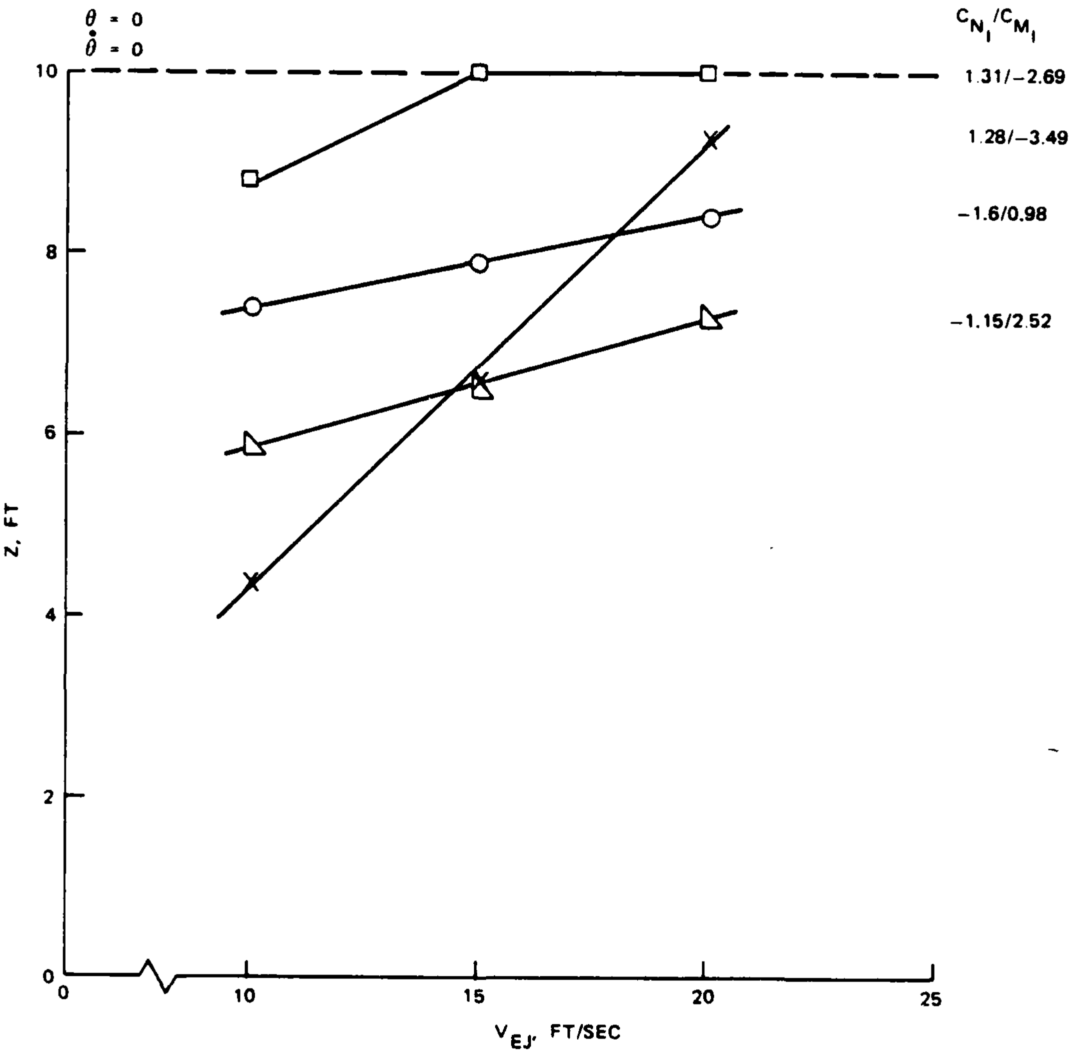
(i) BLU-27 (unstable).

FIGURE 7. (Contd.)



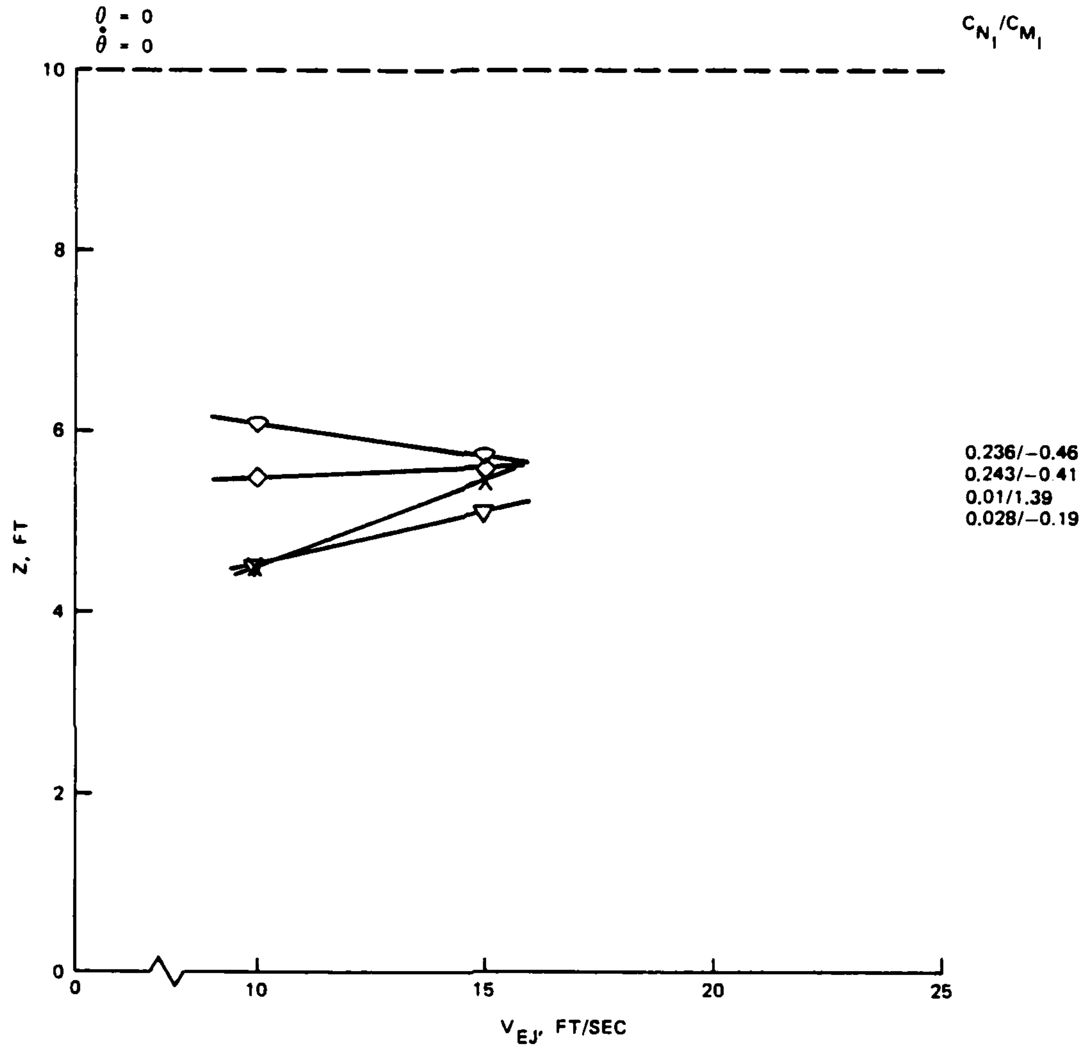
(j) SUU-64 (unstable).

FIGURE 7. (Contd.)



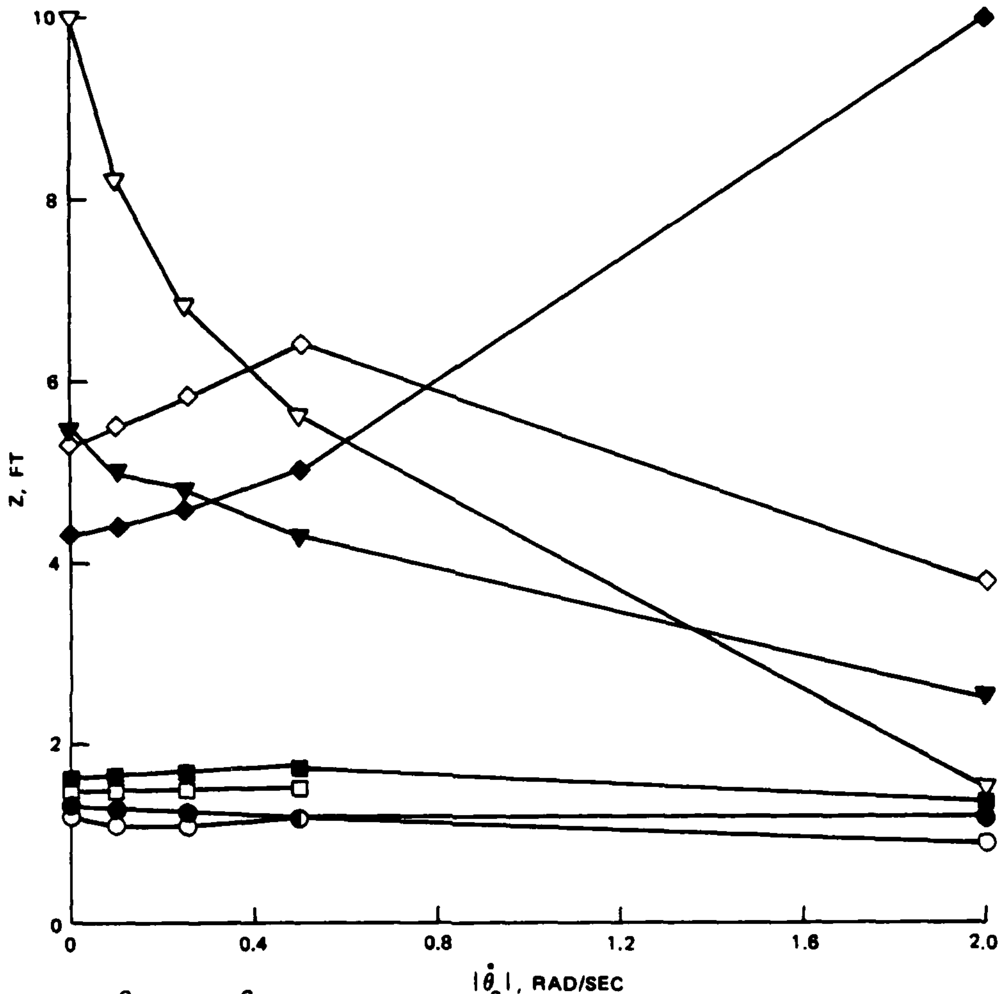
(k) A-10 600-gallon fuel tank (full)(unstable).

FIGURE 7. (Contd.)



(l) F-15 600-gallon tank (full)(unstable).

FIGURE 7. (Contd.)

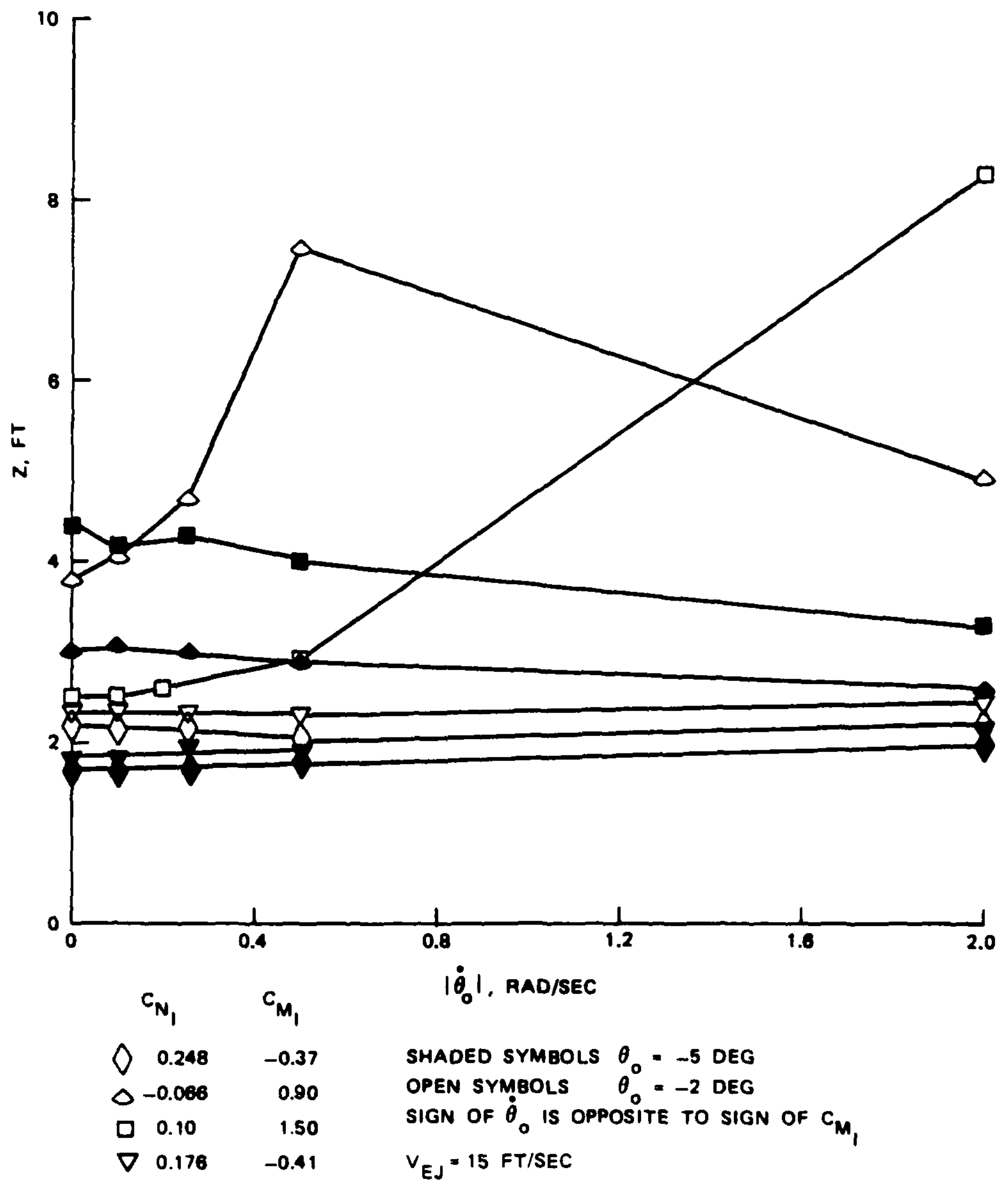


	C_{N_I}	C_{M_I}
□	1.1	−2.26
▽	0.086	0.117
◇	−0.67	−1.1
○	0.83	−2.79

SHADED SYMBOLS θ_o = −5 DEG
OPEN SYMBOLS θ_o = −2 DEG
SIGN OF $\dot{\theta}_o$ IS OPPOSITE TO SIGN OF C_{M_I}
V_{EJ} = 15 FT/SEC

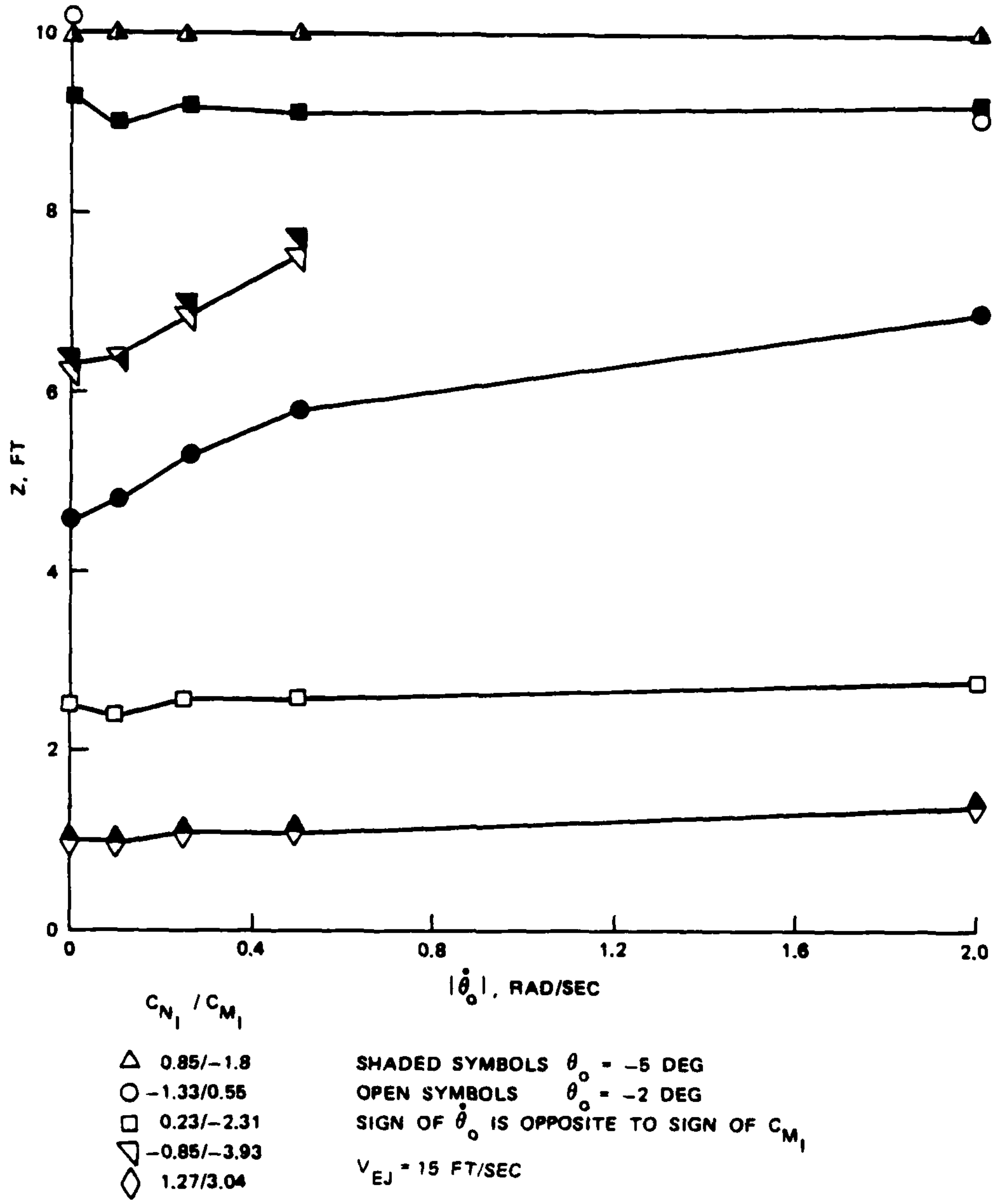
(a) SUU-41 (unstable).

FIGURE 8. Effect of Pitch Rate and Attitude on Individual Store.



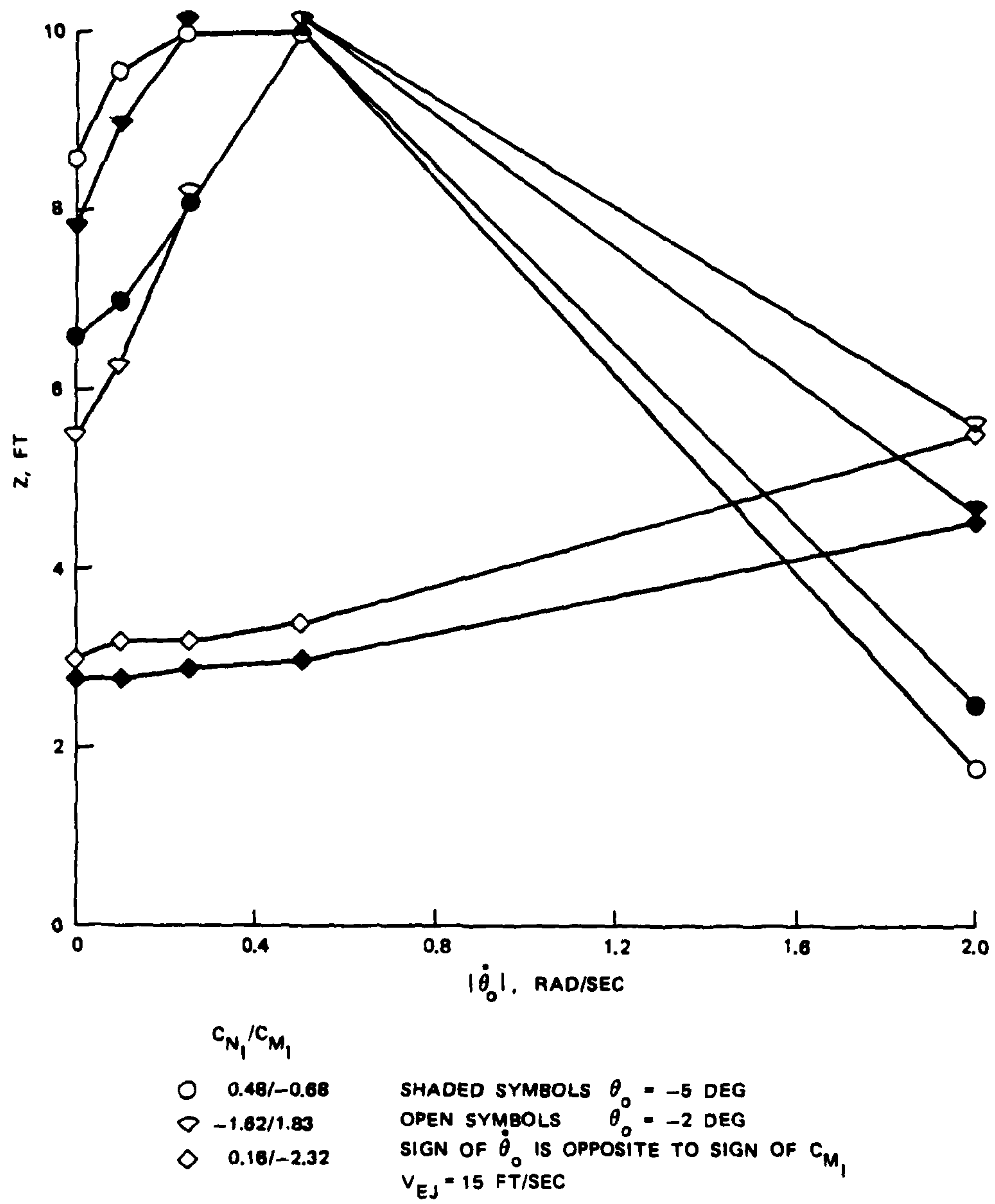
(b) F-15 600-gallon fuel tank (empty)(unstable).

FIGURE 8. (Contd.)



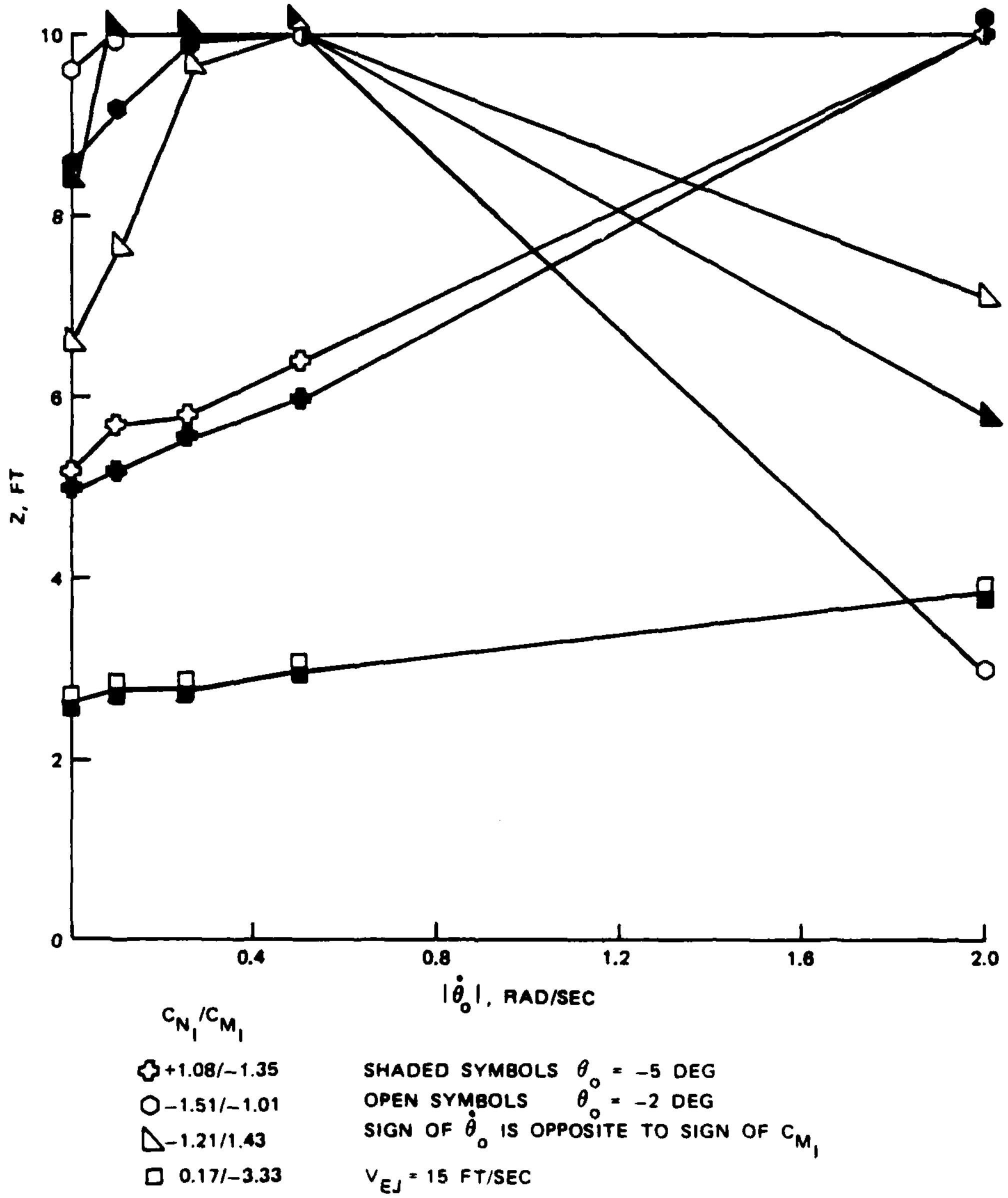
(c) M-117 (stable).

FIGURE 8. (Contd.)



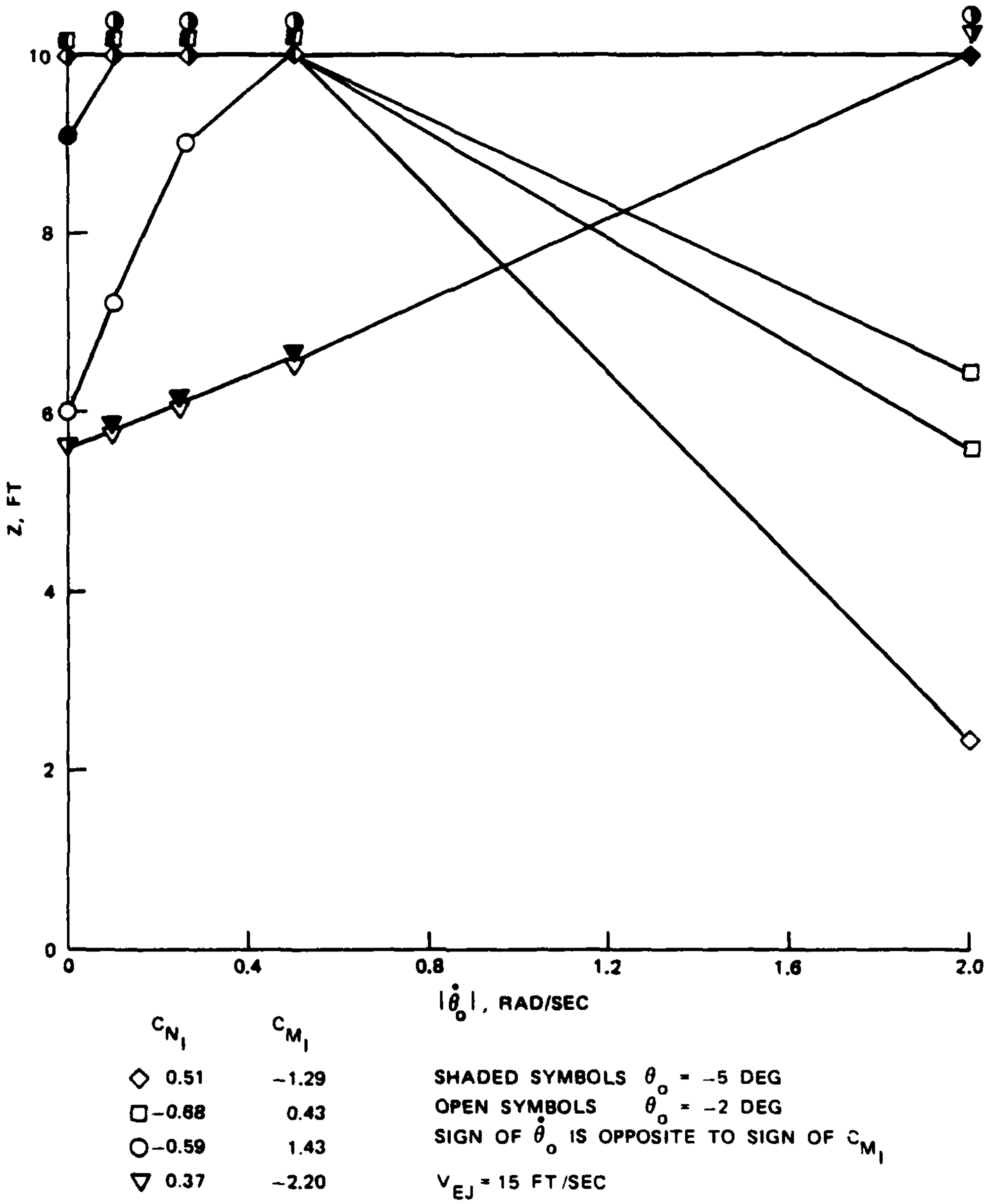
(d) BLU-1 (unstable).

FIGURE 8. (Contd.)



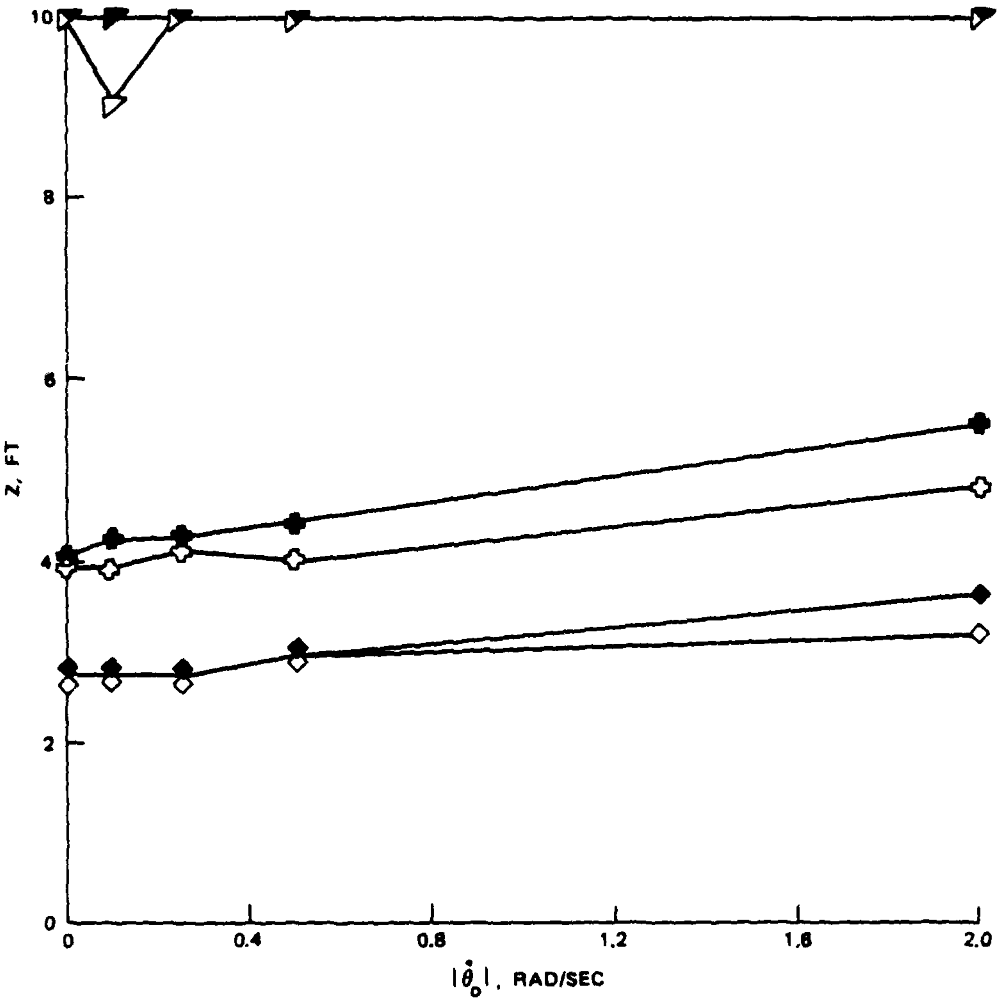
(e) Mk 20 (unstable).

FIGURE 8. (Contd.)



(f) BLU-27 (stable).

FIGURE 8. (Contd.)

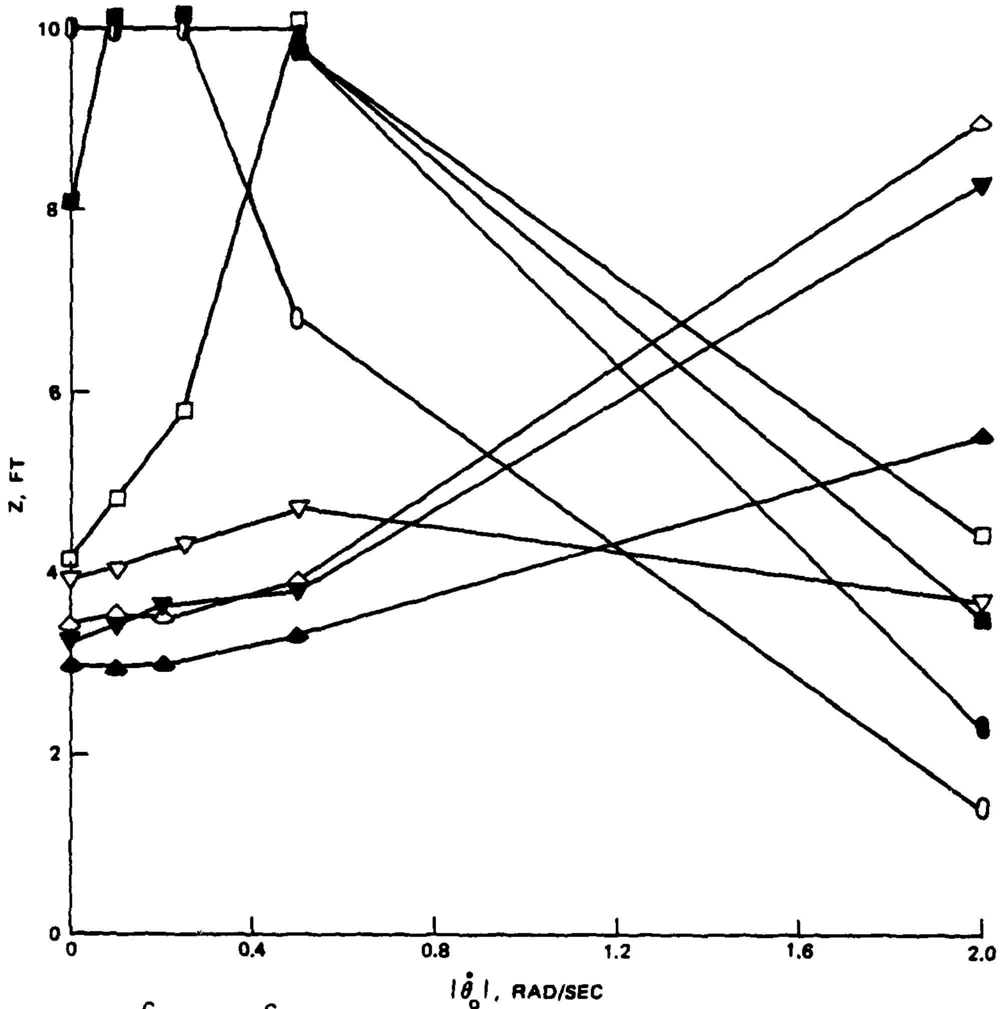


	C_{N_1}	C_{M_1}
✚	0.86	−2.25
▽	−1.94	0.95
◇	0.26	−3.06

SHADED SYMBOLS θ_o = −5 DEG
OPEN SYMBOLS θ_o = −2 DEG
SIGN OF $\dot{\theta}_o$ IS OPPOSITE TO SIGN OF C_{M_1}
V_{EJ} = 15 FT/SEC

(g) SUU-30 (stable).

FIGURE 8. (Contd.)

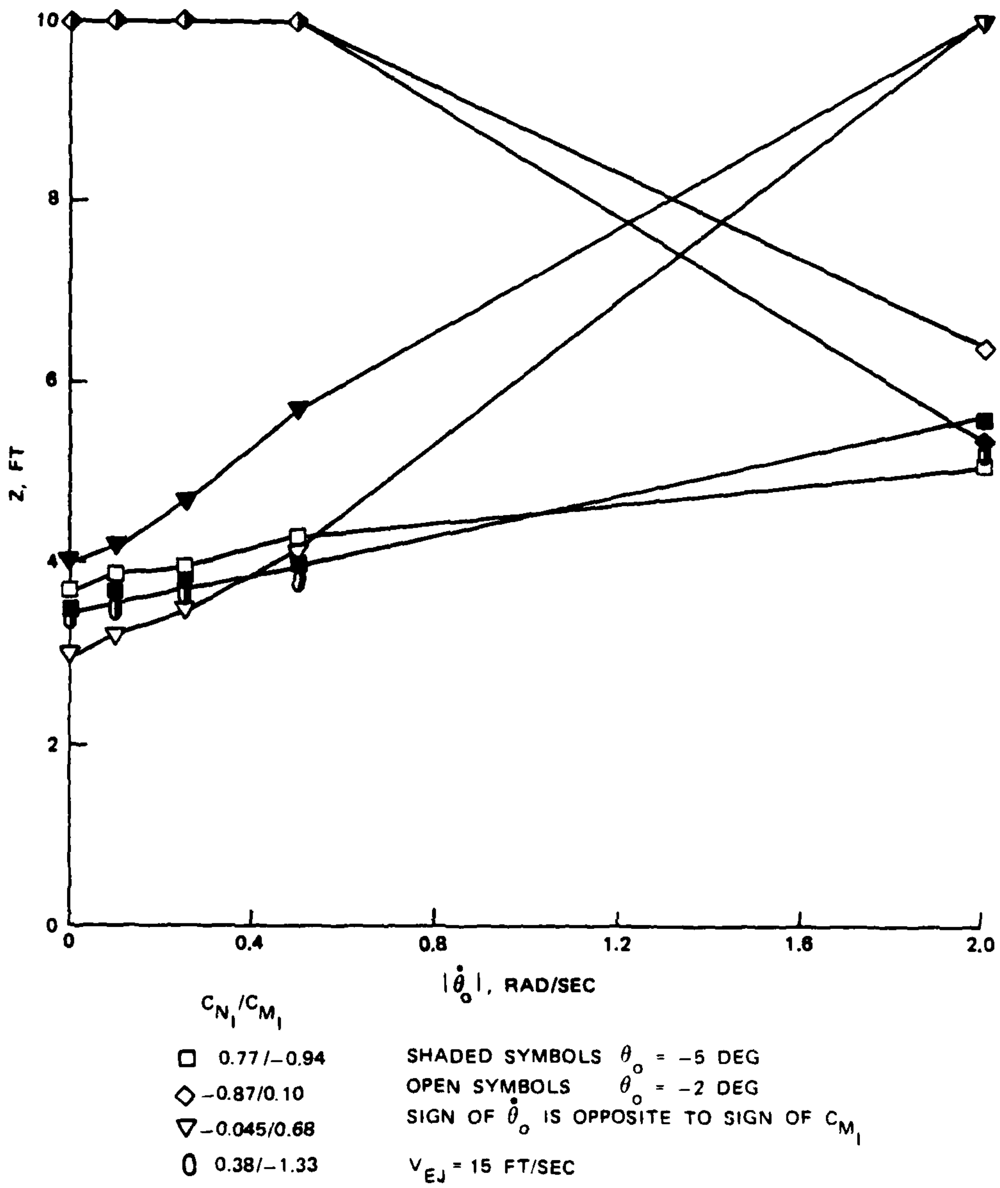


C_{N_I}	C_{M_I}
0 0.60	−0.68
▽ −0.47	−1.0
□ 0.17	0.76
◇ −0.25	−1.46

SHADED SYMBOLS θ_o = −5 DEG
OPEN SYMBOLS θ_o = −2 DEG
SIGN OF $\dot{\theta}_o$ IS OPPOSITE TO SIGN OF C_{M_I}
V_{EJ} = 15 FT/SEC

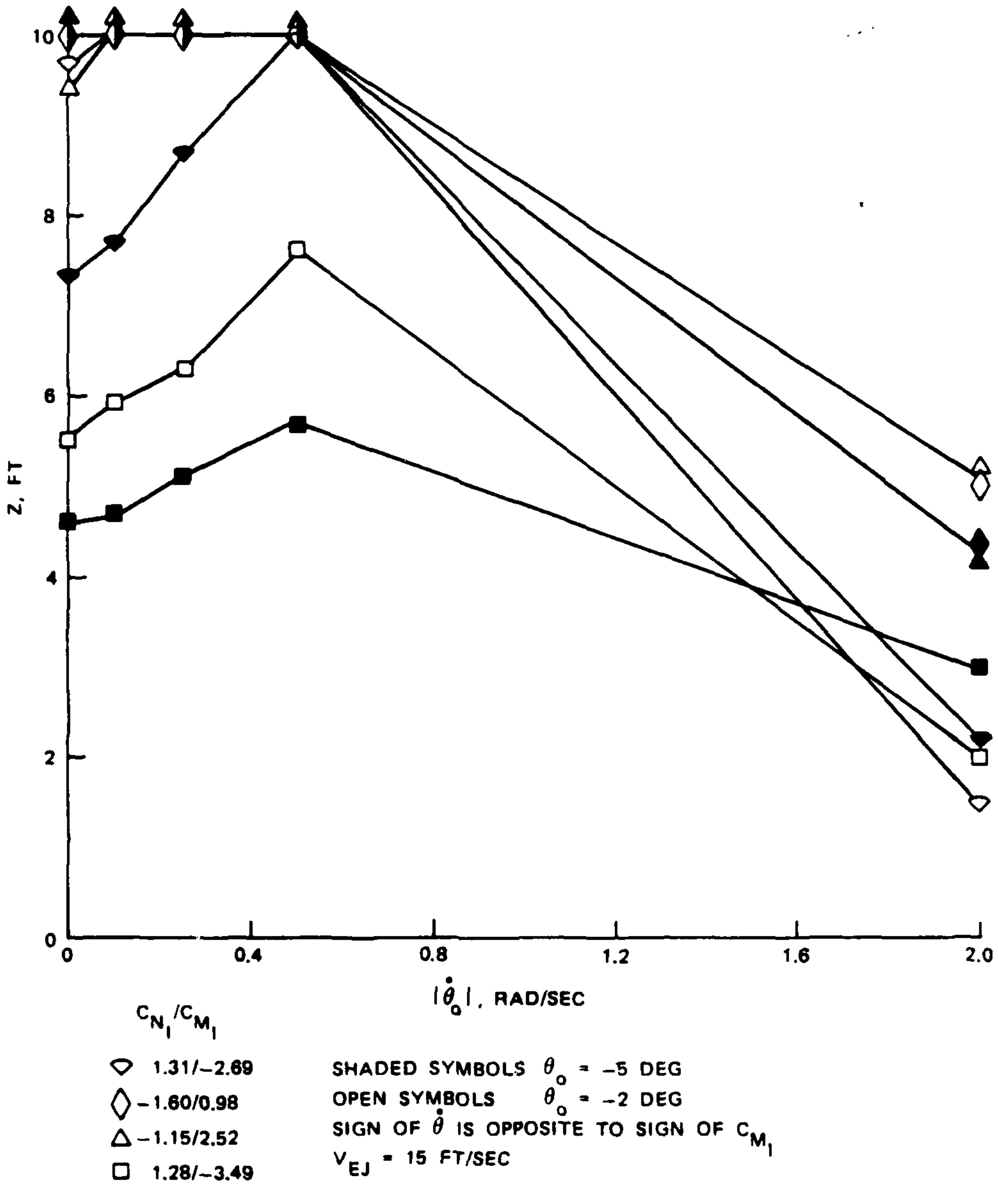
(h) BLU-27 (unstable).

FIGURE 8. (Contd.)



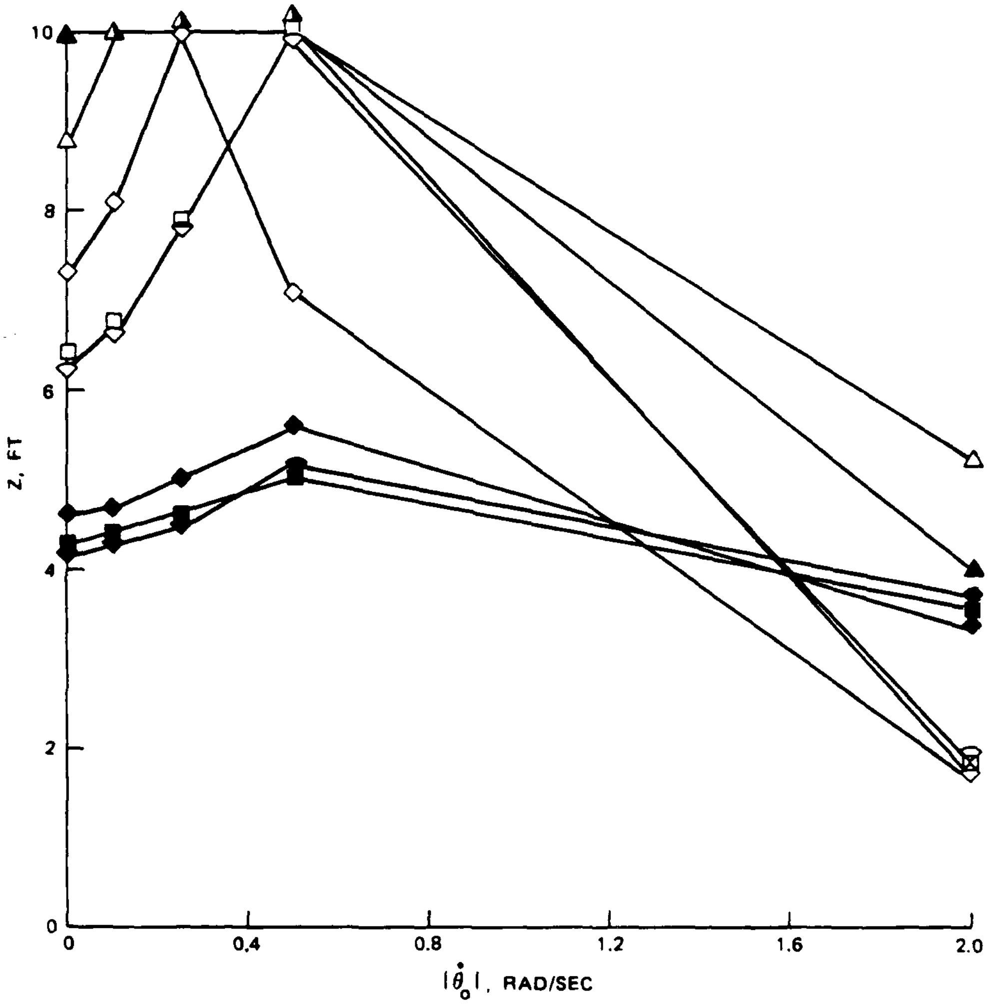
(i) SUU-64 (unstable).

FIGURE 8. (Contd.)



(j) A-10 600-gallon fuel tank (full)(unstable).

FIGURE 8. (Contd.)



C_{N_I}/C_{M_I}

□ 0.243/−0.41 SHADED SYMBOLS θ_o = −5 DEG

◇ −0.028/−0.19 OPEN SYMBOLS θ_o = −2 DEG

△ 0.01/1.39 SIGN OF $\dot{\theta}_o$ IS OPPOSITE TO SIGN OF C_{M_I}

▽ 0.236/−0.46 V_{EJ} = 15 FT/SEC

(k) F-15 600-gallon fuel tank (full)(unstable).

FIGURE 8. (Contd.)

PHASE II

Table 4 provides the results obtained from the specific trajectories for the expanded range of EOE values. Weapons used in the study are listed horizontally across the top of the table. The second row from the top refers to specific captive-load combinations. The column on the left lists the EOE velocity, pitch attitude, and pitch rate used to generate that row of trajectory data. The decimal numbers in columns 1 through 44 are the Z values, i.e., the displacement at which the pitch angle limits were exceeded. All of the 44 Z values for each set of EOE conditions are summed in the right-hand column. These sums provide an indication of how well a specific set of EOE conditions can accommodate all of the stores and load combinations. The highest possible sum is 440, which would indicate that for all weapon and load conditions, the +10 and −30 degree angle limits were not exceeded before the weapon fell 10 feet. Two of these "scores" are of special interest. If an extremely sophisticated ejector system could be built that could achieve any of the EOE values used in the study and could identify the best EOE values for a particular store-load combination, the system would achieve a score of 423. This score represents the sum of the highest Z value in each of the 44 columns (store-load combinations) of Table 4. A system designed to provide a fixed set of EOE values (30 ft/sec, −4 degrees, 0 rad/sec) scores 379 or 90% of the performance of the sophisticated system. For a particular rack, the need to achieve the additional 10% increase in performance will depend on the importance of the stores and loads associated with that increase.

Figures 9, 10, and 11 indicate the sensitivity of each end-of-stroke parameter. The three curves on each graph represent the sum of Z values for aerodynamically stable stores, unstable stores, and all stores. Although the trends are generally similar for both types of stores, the results are accentuated by the response of the unstable weapons. Figure 9 illustrates that separation improves as vertical ejection velocity increases and that the improvement is fairly linear. Store pitch attitude, Figure 10, has very little general effect on stable stores, but −2 to −4 degrees produces best overall results for unstable stores. It is obvious from Figure 11 that unstable stores are greatly influenced by pitch rate. A pitch rate close to zero or slightly negative appears to produce the best general results.

Another possible use for the data in Table 4 would be to provide a relative ranking of different bomb rack designs. If the EOE conditions can be identified that a new rack will produce for the different stores and loads, the Z values can be summed from the table and used to "score" the rack. While only qualitative, a relative evaluation of different design concepts would be possible. An example of this rack scoring for four hypothetical rack designs is provided in Figure 12. As stated earlier, the importance of achieving the higher scores will be determined by the types of stores and the range of aerodynamic loads the rack will have to accommodate. Appendix A illustrates how these scores can be applied to an independent rack design.

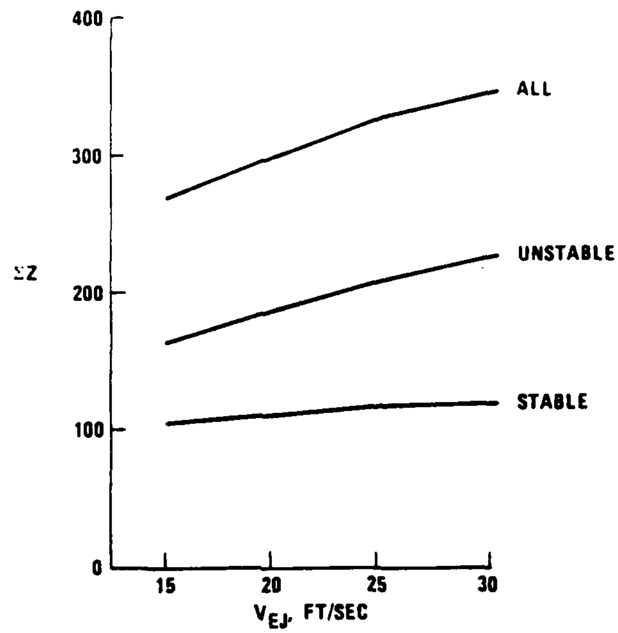


FIGURE 9. General Effect of Vertical Ejection Velocity.

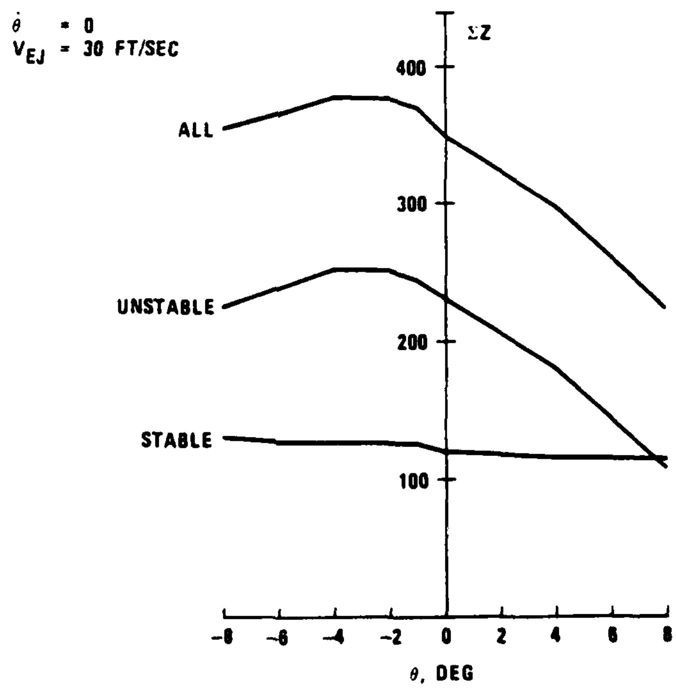


FIGURE 10. General Effect of Store Pitch Attitude.

TABLE 4. Store Vertical Displacements and EOS Matrix.

EOS CONDITIONS INIT VEL	PITCH ANGLE	PITCH RATE	SUU-41 1	2	3	4	F18" TANK 5	6	7	8	SUU-42 9	10	11	M117 12	13	14	BLU-1-U 15	16	17	18
15.0	-8.0	-4.0	1.2	2.2	1.6	.9	1.8	2.8	2.8	1.8	3.1	10.0	10.0	8.1	6.8	2.3	1.7	1.9	1.6	1.7
15.0	-8.0	-2.0	1.4	3.0	2.7	1.2	1.3	2.6	3.1	1.7	10.0	10.0	10.0	10.0	8.8	10.0	2.1	3.0	2.1	2.4
15.0	-8.0	0	1.6	3.6	4.6	1.4	2.2	2.3	3.5	1.8	10.0	10.0	10.0	10.0	8.1	10.0	3.8	10.0	2.4	4.7
15.0	-8.0	2.0	2.0	7.0	3.1	1.7	1.8	3.2	4.7	2.6	10.0	10.0	10.0	10.0	2.4	10.0	3.3	2.5	3.3	10.0
15.0	-8.0	4.0	1.1	2.9	1.6	1.1	2.8	4.0	6.1	2.1	1.4	10.0	10.0	10.0	1.5	10.0	1.5	1.3	2.3	.9
20.0	-8.0	-4.0	1.6	2.6	2.0	1.2	1.7	3.2	2.9	2.2	3.6	10.0	10.0	9.7	6.5	10.0	2.0	1.9	2.2	2.2
20.0	-8.0	-2.0	1.9	3.4	3.2	1.6	1.6	2.9	3.6	2.0	10.0	10.0	10.0	10.0	8.8	10.0	2.7	3.6	2.6	3.1
20.0	-8.0	0	2.5	5.3	5.7	1.9	2.5	2.8	4.1	1.8	10.0	10.0	10.0	10.0	10.0	10.0	4.6	10.0	3.7	6.7
20.0	-8.0	2.0	3.1	8.0	4.0	2.4	2.2	3.6	6.4	2.8	10.0	10.0	10.0	10.0	2.9	10.0	3.9	3.2	8.1	10.0
20.0	-8.0	4.0	1.8	3.5	2.1	2.3	3.0	4.4	7.8	2.4	1.9	10.0	10.0	10.0	1.8	10.0	2.0	1.7	2.8	2.0
25.0	-8.0	-4.0	2.0	3.0	2.4	1.8	2.0	3.9	3.4	2.4	4.4	10.0	10.0	10.0	9.7	10.0	2.4	2.9	2.4	2.7
25.0	-8.0	-2.0	2.4	3.9	3.6	2.0	3.2	3.2	4.1	2.2	10.0	10.0	10.0	10.0	10.0	10.0	3.0	4.2	2.8	3.8
25.0	-8.0	0	3.2	5.9	6.6	2.4	2.8	4.6	4.8	2.0	10.0	10.0	10.0	10.0	10.0	10.0	6.2	10.0	3.4	8.1
25.0	-8.0	2.0	4.2	9.8	4.8	3.0	2.6	4.0	6.1	3.2	10.0	10.0	10.0	10.0	4.2	10.0	4.7	3.9	6.4	10.0
25.0	-8.0	4.0	2.6	4.1	2.1	3.2	3.4	4.8	9.4	2.8	2.4	10.0	10.0	10.0	2.2	10.0	2.1	2.1	3.1	2.5
30.0	-8.0	-4.0	2.4	3.4	2.8	1.8	2.3	3.9	3.8	2.7	5.1	10.0	10.0	10.0	10.0	10.0	2.8	3.4	2.6	3.2
30.0	-8.0	-2.0	2.9	4.4	4.4	2.4	3.5	3.8	4.6	2.5	10.0	10.0	10.0	10.0	10.0	10.0	3.5	5.7	3.0	4.5
30.0	-8.0	0	3.9	6.5	7.5	2.8	3.2	4.9	6.4	4.0	10.0	10.0	10.0	10.0	10.0	10.0	7.2	10.0	3.8	10.0
30.0	-8.0	2.0	5.8	10.0	5.7	3.7	2.9	4.4	7.9	3.6	10.0	10.0	10.0	10.0	4.9	10.0	5.5	4.5	7.4	10.0
30.0	-8.0	4.0	2.8	4.8	2.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15.0	-4.0	-4.0	[illegible]	2.1	2.0	1.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.0	10.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.0
15.0	-4.0	-2.0	1.6	3.7	3.0	1.4	2.5	3.9	4.4	2.0	10.0	10.0	10.0	9.3	10.0	2.7	2.4	3.9	1.6	2.7
15.0	-4.0	0	1.7	8.2	6.4	1.4	2.1	4.4	6.2	2.9	10.0	10.0	10.0	10.0	10.0	10.0	5.6	8.1	3.2	5.4
15.0	-4.0	2.0	1.2	10.0	1.9	1.3	2.4	5.1	3.1	2.2	10.0	10.0	10.0	10.0	2.3	10.0	2.2	2.1	4.8	10.0
15.0	-4.0	4.0	.9	1.7	.9	-.2	2.4	3.1	2.0	2.6	1.1	10.0	10.0	10.0	1.0	3.2	1.2	1.0	1.2	1.2
20.0	-4.0	-4.0	1.5	2.4	2.5	1.6	2.1	3.4	3.8	2.6	4.3	10.0	10.0	2.7	9.2	2.0	1.9	3.0	2.2	2.6
20.0	-4.0	-2.0	2.2	4.2	3.6	1.9	2.9	4.3	5.0	2.3	10.0	10.0	10.0	10.0	10.0	10.0	3.1	3.6	2.8	3.5
20.0	-4.0	0	2.5	5.9	6.6	2.0	2.4	4.8	9.4	3.2	10.0	10.0	10.0	10.0	10.0	10.0	7.6	9.7	3.6	6.9
20.0	-4.0	2.0	2.7	10.0	2.4	2.1	2.8	8.0	3.8	4.0	10.0	10.0	10.0	10.0	2.9	10.0	2.5	2.6	6.9	10.0
20.0	-4.0	4.0	1.3	2.1	1.2	.7	3.8	3.6	2.3	4.3	1.5	10.0	10.0	10.0	1.3	10.0	1.5	1.3	1.6	1.6
25.0	-4.0	-4.0	1.9	2.8	3.0	2.0	2.4	3.4	5.4	2.9	5.0	10.0	10.0	3.3	10.0	2.4	3.0	3.6	2.5	3.2
25.0	-4.0	-2.0	2.7	4.8	4.1	2.4	3.3	4.7	6.6	2.6	10.0	10.0	10.0	10.0	10.0	10.0	4.2	5.5	3.1	4.9
25.0	-4.0	0	3.3	6.6	9.6	2.6	4.1	6.7	10.0	3.6	10.0	10.0	10.0	10.0	10.0	10.0	8.7	10.0	4.7	8.1
25.0	-4.0	2.0	4.3	9.3	3.0	2.9	4.4	10.0	3.9	4.3	10.0	10.0	10.0	10.0	3.5	10.0	3.1	3.2	6.9	10.0
25.0	-4.0	4.0	1.7	2.4	1.5	1.6	4.1	3.9	2.6	4.6	1.8	10.0	10.0	10.0	1.6	10.0	1.9	1.6	2.0	2.0
30.0	-4.0	-4.0	2.9	3.2	3.5	2.4	4.1	5.7	6.0	3.2	5.8	10.0	10.0	3.9	10.0	2.8	3.4	4.1	2.8	3.8
30.0	-4.0	-2.0	3.3	5.3	4.9	2.9	3.6	6.8	8.3	4.8	10.0	10.0	10.0	10.0	10.0	10.0	4.6	7.2	3.9	5.8
30.0	-4.0	0	4.7	7.2	10.0	3.2	4.4	7.0	8.1	3.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	5.1	10.0
30.0	-4.0	2.0	6.7	9.2	3.6	3.7	4.6	7.9	4.6	4.6	10.0	10.0	10.0	10.0	4.1	10.0	3.7	3.2	10.0	10.0
30.0	-4.0	4.0	2.1	2.8	1.8	3.1	5.8	3.8	3.4	4.8	2.2	10.0	10.0	10.0	1.9	10.0	1.8	1.8	2.4	2.4
15.0	0	-4.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.0	10.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15.0	0	-2.0	1.6	4.3	3.6	1.1	2.8	2.0	2.2	2.8	10.0	10.0	10.0	9.2	10.0	1.9	3.1	4.7	2.1	3.0
15.0	0	0	1.7	6.8	3.4	1.3	.4	1.5	1.6	.2	10.0	10.0	10.0	9.8	10.0	2.4	9.5	5.3	3.3	6.0
15.0	0	2.0	.2	2.7	1.2	.8	.6	1.1	1.1	.8	1.6	10.0	10.0	10.0	1.8	2.6	1.5	1.3	2.7	2.3
15.0	0	4.0	.7	1.1	.9	.8	.6	.9	.6	.6	.8	10.0	10.0	9.7	1.0	2.5	.9	.9	.9	.9
20.0	0	-4.0	1.8	3.2	3.0	1.4	2.9	3.7	4.5	3.4	4.7	10.0	10.0	2.6	9.9	1.9	2.5	2.9	2.0	2.5
20.0	0	-2.0	2.3	4.9	4.6	1.6	3.8	2.4	2.6	4.0	10.0	10.0	10.0	10.0	10.0	2.4	3.9	6.5	3.2	4.4
20.0	0	0	2.7	8.5	4.5	2.0	1.4	1.6	1.6	1.5	10.0	10.0	10.0	10.0	10.0	3.0	10.0	5.9	4.6	[illegible]
20.0	0	2.0	.1	3.2	1.6	1.7	1.2	1.5	1.5	1.1	2.4	10.0	10.0	10.0	2.3	3.4	1.6	1.7	2.8	[illegible]
20.0	0	4.0	1.0	1.4	1.2	1.0	1.0	1.1	1.1	1.0	1.1	10.0	10.0	10.0	1.1	3.3	.9	1.2	1.1	1.2
25.0	0	-4.0	2.3	3.7	3.6	1.8	4.3	3.8	4.9	8.3	5.5	10.0	10.0	3.2	10.0	2.8	2.9	3.5	2.4	3.1
25.0	0	-2.0	3.0	5.6	5.5	2.1	4.5	2.5	3.2	4.8	10.0	10.0	10.0	10.0	10.0	2.8	4.7	7.6	3.6	5.4
25.0	0	0	3.7	9.3	6.1	2.7	2.0	2.0	2.3	2.0	10.0	10.0	10.0	10.0	10.0	3.6	10.0	6.4	5.6	10.0
25.0	0	2.0	.1	3.1	2.0	2.7	1.8	1.5	1.8	1.6	10.0	10.0	10.0	10.0	2.8	4.1	2.0	2.1	3.0	3.9
25.0	0	4.0	1.3	1.7	1.5	1.4	1.3	1.4	1.4	1.3	1.4	10.0	10.0	10.0	1.6	3.8	1.4	1.5	1.4	1.5
30.0	0	-4.0	2.8	4.1	4.1	2.2	5.9	4.3	5.2	5.3	8.4	10.0	10.0	3.8	10.0	2.7	3.3	4.8	3.6	3.7
30.0	0	-2.0	3.7	6.2	6.3	2.8	8.3	3.0	3.4	6.8	10.0	10.0	40.0	10.0	10.0	3.4	8.6	8.8	4.5	6.4
30.0	0	0	4.7	10.0	6.0	3.3	2.4	2.3	2.8	2.4	10.0	10.0	10.0	10.0	10.0	4.1	10.0	7.3	6.7	10.0
30.0	0	2.0	3.6	3.8	2.4	3.8	1.8	1.7	2.2	1.8	10.0	10.0	10.0	10.0	3.3	10.0	2.4	2.4	3.5	4.1
30.0	0	4.0	1.6	2.0	1.8	1.8	1.7	1.7	1.7	1.7	1.7	10.0	10.0	10.0	1.9	5.8	1.7	1.8	1.7	1.8
15.0	4.0	-4.0	1.4	3.4	2.7	1.2	.5	1.1	1.3	.6	4.1	10.0	10.0	2.0	9.1	1.4	8.2	3.2	2.5	2.3
15.0	4.0	-2.0	1.6	4.8	4.8	1.1	.5	.8	1.0	.5	10.0	10.0	10.0	8.8	10.0	1.8	4.0	6.3	3.1	3.3
15.0	4.0	0	1.2	10.0	1.7	.9	.5	.5	.8	.4	10.0	10.0	10.0	9.6	10.0	2.9	2.9	2.8	4.5	8.0
15.0	4.0	2.0	.8	1.1	.8	-.2	.4	.5	.6	-.4	1.0	10.0	10.0	9.3	1.0	2.1	.9	.9	.9	1.2
15.0	4.0	4.0	.5	.7	.8	.4	.4	.5	.6	.4	.5	-.1	-.1	.8	.6	2.4	.8	.6	.5	.6
20.0	4.0	-4.0	2.0	3.9	3.4	1.6	1.0	1.1	1.8	.9	5.0	10.0	10.0	2.6	10.0	1.8	3.0	3.4	2.9	3.0
20.0	4.0	-2.0	2.4	5.5	5.9	1.7	.8	1.0	1.4	.8	10.0	10.0	10.0	10.8	10.0	2.3	4.8	6.4	3.6	4.8
20.0	4.0	0	2.4	10.0	2.3	1.7	.7	.7	1.1	.8	10.0	10.0	10.0	10.0	10.0	2.8	4.3	3.1	5.3	8.4
20.0	4.0	2.0	1.2	1.4	1.2	.1	.6	.7	.7	.6	1.3	10.0	10.0	10.0	1.3	2.8	1.1	1.2	1.1	1.6
20.0	4.0	4.0	.7	.9	.8	.6	.6	.7	.7	.5	.7	10.0	10.0	.8	.8	3.0	.7	.8	.7	.8
25.0	4.0	-4.0	2.6	4.5	4.1	2.1	1.3	1.4	2.2	1.3	5.9	10.0	10.0	3.2	10.0	2.2	3.5	4.8	3.2	3.7
25.0	4.0	-2.0	3.2	6.2	7.9	2.3	1.1	1.3	1.8	1.0	10.0	10.0	10.0	10.0	10.0	2.8	8.9	9.7	4.5	5.9
25.0	4.0	0	3.6	9.8	2.8	2.8	1.0	.9	1.4	.8	10.0	10.0	10.0	10.0	10.0	3.4	4.0	3.2	8.1	10.0
25.0	4.0	2.0	1.6	1.7	1.4	1.2	.8	.8	.9	.8	1.7	10.0	10.0	10.0	2.2	3.2	1.4	1.8	1.4	2.0
25.0	4.0	4.0	.9	1.1	1.0	.8	.8	.9	.9	.7	.9	10.0	10.0	1.0	1.0	3.7	.9	1.0	.9	1.0
30.0	4.0	-4.0	3.2	5.0	4.7	2.6	1.7	1.7	2.2	1.6	6.9	10.0	10.0	3.8	10.0	2.6	4.0	5.5	3.6	4.4
30.0	4.0	-2.0	4.0	6.9	9.0	2.9	1.4	1.8	1.7	1.3	10.0	10.0	10.0	10.0	10.0	3.3	8.8	10.0	5.4	7.0
30.0	4.0	0	5.3	9.8	3.4	3.2	1.3	1.1	1.7	1.0	10.0	10.0	10.0	10.0	10.0	4.0	3.8	3.7	9.8	10.0
30.0	4.0	2.0	2.0	2.0	1.7	2.3	1.0	1.1	1.1	1.0	2.1	10.0	10.0	10.0	2.8	3.8	1.8	1.8	1.6	2.4
30.0	4.0	4.0	1.1	1.1	1.2	1.0	1.0	1.1	1.1	.8	1.1	10.0	10.0	1.2	1.2	4.4	1.1	[illegible]	1.0	[illegible]
15.0	8.0	-4.0	1.2	4.3	2.9	.9	.4	.5	.8	.3	4.2	10.0	10.0	1.9	[illegible]	1.3	2.7	3.2	2.2	2.8
15.0	8.0	-2.0	1.4	6.0	6.0	1.0	.4	.5	.5	.3	10.0	10.0	10.0	3.0	10.0	1.7	4.9	10.0	3.3	3.9
15.0	8.0	0	.0	2.0	.8	.2	.2	.3	.5	.2	10.0	10.0	10.0	8.9	10.0	1.6	.9	.9	.7	6.4
15.0	8.0	2.0	.3	.3	.3	.4	.2	.3	.3	.2	.3	-.2	-.1	8.7	.3	1.9	.3	.3	.3	.3
15.0	8.0	4.0	.3	.3	.3	.3	.2	.3	.3	.2	.3	.2	.2	.3	.3	1.7	.3	.3	.2	.3
20.0	8.0	-4.0	1.6	4.8	4.4	1.4	.8	.7	1.0	.8	8.2	10.0	10.0	2.5	10.0	1.7	3.3	4.4	3.3	3.4
20.0	8.0	-2.0	2.3	6.8	6.1	1.8	.5	.7	.7	.6	10.0	10.0	10.0	3.8	10.0	2.2	8.7	10.0	4.4	8.1
20.0	8.0	0	1.4	2.4	1.1	1.2	.3	.4	.7	.3	10.0	10.0	10.0	10.0	10.0	2.1	1.5	1.1	1.0	9.0
20.0	8.0	2.0	.4	.4	.4	.6	.3	.4	.4	.3	.4	10.0	10.0	10.0	.4	2.5	.4	.4	.4	.4
20.0	8.0	4.0	.4	.4	.4	.4	.3	.4	.4	.3	.4	.3	.3	.4	.4	2.2	.4	.4	.3	.4
25.0	8.0	-4.0	2.9	5.2	8.2	1.9	.8	.9	1.3	.7	8.3	10.0	10.0	3.1	10.0	2.1	4.5	5.3	3.6	4.2
25.0	8.0	-2.0	3.2	8.8	7.1	2.3	.7	.9	.9	.7	10.0	10.0	10.0	4.8	10.0	2.7	10.0	10.0	5.9	6.3
25.0	8.0	0	3.0	2.3	1.4	2.2	.4	.5	.9	.4	10.0	10.0	10.0	10.0	10.0	2.6	1.3	.9	1.2	10.0
25.0	8.0	2.0	.5	.5	.5	.5	.4	.5	.6	.4	.5	10.0	10.0	10.0	.6	3.1	.5	.5	.6	.6
25.0	8.0	4.0	.5	.5	.5	.4	.4	.6	.5	.4	.6	.4	.4	.5	.5	2.8	.4	.5	.4	.5
30.0	8.0	-4.0	3.6	5.9	[illegible]	3.0	1.0	1.1	1.6	.9	8.4	10.0	10.0	3.7	10.0	2.5	8.2	6.8	4.2	4.8
30.0	8.0	-2.0	4.1	9.7	7.4	3.0	.9	1.0	1.1	.9	10.0	10.0	10.0	5.7	10.0	3.2	10.0	6.7	7.0	7.5
30.0	8.0	0	5.0	2.7	1.7	3.1	.6	.8	1.1	.6	10.0	10.0	10.0	10.0	10.0	3.1	1.1	1.1	2.2	10.0
30.0	8.0	2.0	.6	.6	.6	.5	.5	.6	.6	.5	.6	10.0	10.0	10.0	.6	3.7	.6	.6	.5	.6
30.0	8.0	4.0	.6	.6	.6	.5	.5	.6	.6	.5	.6	.5	.6	.6	.6	3.4	.5	.6	.5	.6

BLU-1-U			MK 20				BLU-27-F				SUU-30			BLU 27-U				SUU-64				A10 TANK			
[illegible]	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1.7	1.8	1.6	1.7	2.0	2.1	1.4	1.8	1.7	2.2	1.8	1.7	2.2	1.4	1.4	1.5	1.2	1.4	1.4	2.2	2.6	1.4	1.7	1.7	1.7	1.7
2.1	3.0	2.1	2.4	3.7	4.8	1.8	3.8	5.0	8.8	3.1	3.0	10.0	2.4	2.3	1.8	2.2	1.5	2.2	5.0	8.3	2.3	2.8	3.8	3.8	2.4
8.8	10.0	2.4	4.7	7.7	10.0	2.7	10.0	10.0	10.0	8.1	10.0	10.0	10.0	5.3	2.2	3.8	2.0	3.3	10.0	8.1	3.1	6.1	10.0	10.0	4.3
3.3	2.5	3.3	10.0	10.0	2.9	3.9	10.0	2.9	2.9	10.0	10.0	2.9	5.4	3.1	3.5	2.4	3.8	6.1	4.0	2.5	5.3	3.8	3.3	2.9	6.6
1.5	1.3	2.3	1.5	1.9	1.3	5.5	1.6	1.3	1.3	1.6	6.2	1.3	5.3	1.3	2.2	1.3	2.4	1.7	1.9	1.3	6.1	1.6	1.3	1.3	1.5
2.0	1.9	2.2	2.2	2.5	2.7	1.8	2.3	2.2	2.6	2.3	2.2	2.7	1.8	1.8	1.8	2.1	2.1	1.8	2.7	3.2	1.8	2.2	2.2	2.2	2.2
2.7	3.6	2.6	3.1	4.5	6.1	2.3	4.4	6.2	8.9	3.9	4.4	10.0	3.0	2.8	2.6	2.8	1.7	2.7	5.8	8.5	2.8	3.6	4.8	4.8	3.1
8.6	10.0	3.2	6.7	9.9	10.0	3.3	10.0	10.0	10.0	8.2	10.0	10.0	10.0	7.7	3.2	6.4	3.0	4.8	10.0	7.5	3.9	8.4	10.0	10.0	6.8
3.5	3.2	8.1	10.0	10.0	3.7	4.9	10.0	3.7	3.7	10.0	10.0	3.7	10.0	3.5	4.8	3.1	4.8	6.5	4.2	3.2	7.2	4.4	3.7	3.7	7.1
2.0	1.7	2.8	2.0	2.4	1.7	4.8	2.1	1.7	1.7	2.1	10.0	1.7	7.3	1.7	2.7	1.7	2.7	2.3	2.4	1.7	3.6	2.1	1.7	1.7	2.1
8.4	2.9	2.4	2.7	3.0	3.3	2.2	2.8	2.7	3.3	2.8	2.8	3.3	2.2	2.8	2.8	2.4	2.3	2.2	3.2	3.8	2.2	2.7	2.7	2.7	2.7
8.0	4.2	2.8	3.8	5.3	7.2	2.8	5.4	7.4	9.7	4.7	5.3	10.0	3.6	4.1	2.1	3.2	2.8	3.3	8.7	9.8	3.5	4.4	5.8	5.8	3.8
8.2	10.0	3.4	8.1	10.0	10.0	4.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.9	7.0	3.6	5.8	10.0	9.5	5.5	10.0	10.0	10.0	6.7
4.7	3.8	6.4	10.0	10.0	4.5	5.9	10.0	4.5	4.4	10.0	10.0	4.5	10.0	4.3	6.8	3.7	6.0	10.0	5.0	3.8	9.4	5.4	4.5	4.5	7.6
2.1	2.1	3.1	2.5	2.9	2.1	8.8	2.6	2.1	2.1	2.6	10.0	2.1	10.0	2.1	2.8	2.1	3.2	2.9	2.9	2.1	4.0	2.6	2.1	2.1	2.6
2.8	3.4	2.6	3.2	3.5	3.9	2.6	3.3	3.3	4.0	3.3	3.3	3.9	3.4	2.6	2.8	2.8	3.0	2.6	3.7	4.3	2.6	3.2	3.2	3.2	3.2
3.5	5.7	3.0	4.5	6.0	8.4	3.3	6.2	8.6	10.[illegible]	5.5	6.2	10.0	5.0	4.0	2.6	3.5	2.4	3.9	7.5	10.0	4.1	5.2	6.6	6.8	4.5
7.2	10.0	3.8	10.0	10.0	10.0	4.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	4.4	7.8	4.1	6.8	10.0	10.0	6.4	10.0	10.0	10.0	8.7
5.5	4.5	7.4	10.0	10.0	6.3	7.7	10.0	5.2	5.2	10.[illegible]	10.0	5.3	10.0	5.1	6.2	4.4	6.9	10.0	5.8	4.5	10.0	6.4	5.3	5.2	6.3
2.4	2.5	3.[illegible]	3.0	3.4	2.5	10.0	3.[illegible]	2.5	2.5	3.[illegible]	10.0	2.5	10.0	2.5	3.3	2.4	3.6	[illegible]	3.4	2.5	4.8	3.1	2.5	2.5	3.1
1.6	2.3	2.0	2.0	2.5	2.5	1.4	2.2	2.2	2.6	2.2	2.[illegible]	2.6	1.8	1.8	1.6	1.[illegible]	1.5	1.7	2.6	3.0	1.8	2.0	2.[illegible]	2.1	1.6
2.4	3.9	1.8	2.7	4.3	6.4	2.2	4.0	8.1	10.0	3.1	3.4	10.0	2.3	3.0	1.9	2.5	1.8	2.5	6.4	10.0	2.7	3.1	4.7	4.7	2.7
8.8	8.1	3.2	5.4	9.0	10.0	3.0	10.0	10.0	10.0	7.8	10.0	10.0	3.7	10.0	3.7	6.2	2.8	3.9	10.0	4.2	4.0	8.0	10.0	10.0	4.8
2.2	2.1	4.8	10.0	10.0	2.1	4.2	10.0	2.4	2.0	9.8	10.0	2.1	3.9	2.0	10.0	1.6	6.4	6.1	2.3	1.7	6.6	2.3	2.5	2.1	2.8
1.2	1.0	1.2	1.2	1.4	1.3	5.5	1.2	1.3	1.0	1.2	4.5	1.3	4.4	1.2	1.3	.8	1.3	1.1	1.4	1.0	1.5	1.3	1.3	1.3	1.2
1.9	3.0	2.2	2.6	3.1	3.2	1.8	2.8	2.7	3.3	2.3	2.2	3.3	2.3	2.3	1.8	2.0	1.7	2.2	3.3	3.7	2.3	2.8	2.7	2.7	2.1
3.1	3.6	2.8	3.5	5.1	7.9	2.8	5.1	7.5	10.0	4.8	3.7	10.0	2.9	3.9	2.5	3.7	2.9	3.2	7.4	10.0	3.4	4.0	5.9	5.9	3.5
7.8	9.7	3.6	6.9	10.0	10.0	3.8	10.0	10.0	10.0	9.0	10.0	10.0	4.6	10.0	4.6	7.7	3.3	5.0	10.0	5.2	5.0	10.0	10.0	10.0	6.8
2.5	2.6	6.9	10.0	8.6	2.7	5.3	10.0	3.1	2.6	10.0	10.0	3.2	5.5	2.6	6.3	2.1	8.2	8.6	2.9	2.1	7.8	3.0	3.2	2.7	3.3
1.5	1.3	1.6	1.6	1.6	1.7	6.9	1.6	1.7	1.3	1.8	6.5	1.7	5.6	1.6	1.6	1.2	1.7	1.5	1.8	1.1	2.0	1.7	1.7	1.7	1.6
3.0	3.6	2.5	3.2	3.7	3.9	2.2	3.4	3.3	4.0	2.8	2.7	4.0	2.8	2.7	3.0	3.0	2.8	2.7	3.9	4.4	2.8	3.2	3.3	3.3	2.6
4.2	5.5	3.1	4.9	6.0	8.6	3.4	8.0	8.9	10.0	5.4	4.5	10.0	3.4	4.6	2.7	4.2	2.7	3.8	8.4	10.0	4.1	4.9	7.1	7.1	4.3
8.7	10.0	4.7	9.1	10.0	10.0	4.6	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.4	8.7	4.7	6.1	10.0	6.3	5.9	10.0	10.0	10.0	8.4
3.1	3.2	8.9	10.0	8.5	3.3	6.4	10.0	3.8	3.2	10.0	10.0	3.8	6.3	3.1	8.0	2.8	10.0	10.0	3.5	2.6	10.0	3.7	3.9	3.2	4.1
1.9	1.6	2.0	2.0	2.2	2.1	9.7	2.0	2.1	1.8	2.0	10.0	2.1	7.6	1.5	2.0	1.5	2.0	1.9	2.2	1.5	2.5	2.1	2.1	2.1	2.0
3.4	4.1	2.8	3.8	4.3	4.8	3.3	4.0	3.9	4.8	3.2	3.2	4.8	3.3	3.3	3.3	3.5	3.1	3.2	4.5	5.1	3.3	3.8	3.9	3.9	3.1
4.8	7.2	3.9	5.8	6.8	10.0	4.0	7.0	10.0	10.0	6.3	5.3	10.0	4.0	5.4	4.0	5.0	3.9	4.5	9.4	10.0	4.8	6.6	8.3	8.3	5.1
10.0	10.0	5.1	10.0	10.0	10.0	5.4	10.0	10.0	10.0	10.0	10.0	10.0	8.3	10.0	5.8	10.0	5.4	8.0	10.0	7.4	6.9	10.0	10.0	10.0	10.0
3.7	3.2	10.0	10.0	8.8	3.9	8.3	10.0	4.5	3.8	10.0	10.0	4.6	10.0	3.7	6.1	3.1	10.0	10.0	4.1	3.1	10.0	4.4	3.9	3.8	4.9
1.8	1.8	2.4	2.4	2.6	2.5	10.[illegible]	2.4	2.5	.9	2.4	10.0	2.5	9.8	1.8	2.3	1.8	2.1	2.3	2.8	1.8	3.0	2.4	2.8	2.8	2.4
2.0	2.3	1.7	1.8	2.5	2.8	1.7	2.8	2.6	3.0	2.2	2.0	3.0	1.8	2.2	2.0	2.0	1.8	2.1	3.3	4.1	1.7	2.4	2.5	2.8	2.0
3.1	4.7	2.1	3.0	4.8	8.1	2.1	4.4	7.2	10.0	3.4	2.8	10.0	2.7	3.4	3.7	3.8	2.7	2.7	7.7	10.0	2.5	3.9	8.7	5.7	3.0
9.3	5.3	3.3	8.0	10.0	8.3	2.9	10.0	10.0	9.3	6.2	4.4	10.0	3.0	10.0	4.7	3.5	3.4	3.9	9.2	2.7	4.1	10.0	10.0	10.0	8.8
1.5	1.3	2.7	2.3	2.7	1.7	4.0	2.6	1.6	1.8	6.1	5.2	1.7	3.8	1.6	1.7	1.2	2.0	4.9	1.8	1.3	5.7	1.8	1.7	1.7	1.5
.9	.9	.9	.9	1.0	1.0	5.0	.9	1.0	1.0	.9	4.3	1.0	3.6	.9	.8	.9	.8	.8	1.0	.9	.9	.9	1.0	1.0	.9
2.5	2.9	2.0	2.5	3.1	3.7	2.2	3.3	3.2	3.8	2.8	2.8	3.8	2.3	2.7	2.3	2.5	2.2	2.6	4.0	4.9	2.2	3.1	3.2	3.2	2.6
3.9	6.5	3.2	4.4	5.7	9.9	2.7	5.5	8.7	10.0	4.3	3.6	10.0	3.4	4.8	3.5	4.8	2.7	3.5	8.8	10.0	3.2	5.0	7.1	7.1	4.4
10.0	5.9	4.6	7.7	10.0	10.0	3.7	10.0	10.0	10.0	8.4	5.8	10.0	3.8	10.0	8.1	4.4	4.4	8.7	10.0	3.5	5.2	10.0	10.0	10.0	9.4
1.9	1.7	2.8	3.[illegible]	3.4	2.2	8.8	10.0	2.2	2.1	10.0	7.3	2.2	4.7	2.0	2.1	1.8	2.2	8.8	2.3	1.7	7.8	2.1	2.2	2.2	2.0
1.1	1.2	1.1	1.2	1.3	1.3	2.0	1.2	1.3	1.3	1.2	8.7	1.3	4.7	1.2	1.1	1	1.1	1.1	1.3	1.2	1.2	1.2	1.3	1.3	1.8
2.8	3.5	2.4	3.1	3.7	4.5	2.7	3.8	3.8	4.8	3.3	3.2	4.8	2.8	3.3	2.8	2.8	2.8	3.2	4.8	5.8	2.7	3.8	3.8	3.8	3.2
4.7	7.8	3.6	5.4	8.7	10.0	3.3	6.5	10.0	10.0	5.2	4.4	10.0	4.1	5.9	4.1	5.4	4.0	4.3	10.0	10.0	3.9	8.1	8.5	8.4	5.4
10.0	6.4	5.6	10.0	10.0	10.0	5.1	10.0	10.0	10.0	10.0	10.0	10.0	4.5	10.0	6.8	4.9	6.2	6.9	10.0	4.8	6.3	10.0	10.0	10.0	10.0
2.0	2.1	3.0	3.9	4.1	2.7	6.8	4.4	2.7	2.6	10.0	10.0	2.7	5.6	2.1	2.4	2.0	2.7	10.0	2.8	2.0	10.0	2.6	2.7	2.7	2.5
1.4	1.5	1.4	1.5	1.6	1.6	2.0	1.6	1.6	1.6	1.6	8.6	1.6	5.7	1.5	1.3	1.0	1.4	1.4	1.6	1.5	1.5	1.5	1.6	1.8	1.5
3.3	4.8	3.6	3.7	4.2	8.3	3.2	4.6	4.6	5.4	3.9	3.8	5.4	3.2	3.8	3.0	4.1	2.9	3.8	5.3	6.7	4.0	4.4	4.6	4.6	3.7
8.6	8.8	4.5	6.4	7.6	10.0	3.9	7.6	10.0	10.0	8.1	5.9	10.0	4.7	6.8	4.6	8.4	4.4	5.1	10.0	10.0	5.4	7.2	8.8	10.0	8.4
10.0	7.3	6.7	10.0	10.0	10.0	6.0	10.0	10.0	10.0	10.0	10.0	10.0	6.1	10.0	6.2	5.7	7.2	8.2	10.0	5.7	7.3	10.0	10.0	10.0	10.0
2.4	2.4	3.5	4.1	4.8	3.2	8.8	5.2	3.1	3.1	10.0	10.0	3.2	7.4	2.4	2.6	2.4	3.1	8.4	3.3	2.4	10.0	3.1	3.2	3.2	3.0
1.7	1.8	1.[illegible]	1.8	.9	1.9	2.4	1.8	1.8	.8	1.8	10.0	1.9	6.7	1.8	1.5	1.2	.6	1.[illegible]	1.8	1.8	1.8	1.8	1.8	1.8	1.8
2.2	3.2	2.5	2.3	3.0	3.4	1.7	2.4	3.0	3.4	2.5	2.0	3.4	1.7	2.8	2.8	2.4	2.4	1.9	3.8	5.1	2.1	2.7	2.8	2.8	2.3
4.0	6.3	3.1	3.3	5.3	9.9	2.5	4.0	8.2	10.0	3.7	3.2	10.0	2.8	4.2	3.8	4.8	2.5	2.8	9.8	9.2	2.8	4.7	8.8	7.2	3.7
2.9	2.8	4.5	8.0	10.0	5.6	3.2	8.1	10.0	5.9	5.3	4.2	10.0	2.8	4.2	2.5	1.8	8.1	4.1	4.1	1.9	4.2	7.6	8.6	6.1	8.9
.9	.9	.9	1.2	1.4	1.0	4.2	1.2	1.0	1.0	1.6	3.5	1.0	2.9	.9	.9	.9	.9	1.1	1.0	.9	5.4	.9	1.0	1.0	.9
.8	.8	.5	.6	.6	.8	.6	.6	.6	.6	.8	.8	.6	2.8	.6	.6	.8	.5	.6	.6	.6	.8	.8	.8	.6	.6
3.0	3.4	2.9	3.0	3.6	4.3	2.2	3.1	3.7	4.3	3.1	2.8	4.3	2.2	3.2	3.1	2.9	3.2	2.5	4.6	8.1	2.7	3.5	3.7	3.7	3.0
4.6	8.4	3.6	4.8	6.3	10.0	3.2	5.1	9.1	10.0	4.6	4.0	10.0	3.2	5.8	4.3	6.7	3.8	3.8	10.0	10.0	3.8	6.0	8.3	8.8	4.8
4.3	3.1	5.3	8.4	10.0	7.0	4.1	10.0	10.0	7.9	6.7	5.4	10.0	3.6	3.9	2.7	2.1	10.0	5.5	5.0	2.5	5.3	8.4	6.2	8.8	9.4
1.1	1.2	1.1	1.6	1.8	1.3	5.3	1.6	1.3	1.3	2.0	5.2	1.3	3.8	1.2	1.0	1.1	1.1	1.5	1.3	1.2	8.1	1.2	1.3	1.3	1.2
.7	.8	.7	.8	.9	.8	.8	.8	.8	.8	.6	.8	.8	3.9	.8	.6	.7	.7	.8	.8	.8	.8	.8	.8	.8	.8
3.5	4.8	3.2	3.7	4.3	5.2	2.7	3.6	4.5	5.2	3.8	3.2	5.2	2.7	3.9	3.5	4.2	3.5	3.1	5.3	7.2	3.3	4.3	4.8	4.5	3.7
8.9	9.7	4.5	5.9	7.4	10.0	3.8	8.1	10.0	10.0	5.8	4.3	10.0	3.9	7.1	4.7	7.9	4.7	4.7	10.0	10.0	4.4	7.3	10.0	10.0	6.5
4.0	3.2	8.1	10.0	10.0	8.3	4.9	10.0	10.0	10.0	9.0	6.6	10.0	4.4	4.1	3.2	2.8	4.8	7.5	5.9	3.1	6.5	9.0	9.8	8.3	9.7
1.4	1.5	1.4	2.0	2.2	1.8	7.1	2.0	1.5	1.6	2.6	6.5	1.6	4.6	1.5	1.2	1.4	1.3	1.9	1.6	1.5	10.0	1.6	1.6	1.6	1.6
.9	1.0	.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.9	1.0	.8	.9	.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4.0	5.5	3.6	4.4	5.0	6.1	3.2	4.5	5.3	6.1	4.5	3.8	6.1	3.2	4.8	3.9	4.8	3.8	4.4	6.1	8.3	3.8	8.1	5.3	5.3	4.4
8.8	10.0	8.4	7.0	8.4	10.0	4.5	7.2	10.0	10.0	8.8	5.1	10.0	4.8	9.0	5.4	10.0	8.4	5.6	10.0	10.0	5.1	9.4	10.0	10.0	7.7
3.8	3.7	8.8	10.0	10.0	9.7	5.8	10.0	10.0	10.0	10.0	7.7	10.0	5.1	4.2	3.7	3.0	8.8	9.8	6.9	3.6	8.5	8.8	10.0	9.7	10.0
1.8	1.8	1.8	2.4	2.6	1.9	9.2	2.4	1.8	1.8	3.0	7.0	1.9	5.5	1.7	1.2	1.2	1.5	2.3	1.9	1.8	10.0	1.8	1.9	1.8	1.8
1.[illegible]	1.2	1.2	1.2	1.3	1.2	[illegible]	1.2	1.2	1.2	1.2	1.2	1.2	5.8	1.2	1.0	1.1	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
2.7	3.2	2.2	2.8	3.8	3.8	2.1	2.8	3.4	3.8	2.4	1.8	3.8	2.1	2.8	2.8	3.1	8.8	2.1	5.0	8.7	2.4	3.1	3.3	3.3	2.8
4.8	10.0	3.3	3.9	5.8	10.0	2.4	4.2	9.2	10.0	3.5	2.8	10.0	1.9	5.8	3.5	3.8	4.0	2.9	10.0	4.7	3.0	5.8	8.4	8.8	4.4
.9	.8	.7	6.4	10.0	2.8	3.5	7.7	10.0	3.6	5.7	3.1	10.0	2.8	1.2	.5	.6	.5	3.9	1.7	.9	4.0	2.9	3.3	2.8	2.8
.3	.3	.3	.3	.3	.3	.6	.3	.3	.3	.3	.6	.3	2.8	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
.3	.3	.2	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.2	.3	.3	.3	.3	.3	.3	.3	.3	.3
3.3	4.4	3.3	3.4	4.2	4.8	2.8	3.5	4.2	4.8	3.1	2.4	4.9	2.7	3.7	3.2	3.9	3.2	2.8	6.0	8.1	3.1	4.0	4.2	4.2	3.4
8.7	10.0	4.4	5.1	6.9	10.0	3.1	5.4	10.0	10.0	4.4	3.2	10.0	2.4	8.0	2.4	4.2	8.8	3.9	10.0	6.1	3.8	7.8	10.0	10.0	8.2
1.5	1.1	1.0	8.0	10.0	3.6	4.4	10.0	10.0	4.5	7.2	4.1	10.0	3.3	1.1	.7	1.1	.7	8.8	2.2	1.2	8.8	3.8	4.2	3.8	3.7
.4	.4	.4	.4	.4	.4	.8	.4	.4	.4	.4	.8	.4	3.7	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4
.4	.4	.3	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.3	.4	.3	.4	.4	.4	.4	.4	.4	.4	.4
4.9	5.3	3.8	4.2	5.0	5.8	3.2	4.3	5.1	5.1	3.8	3.0	5.8	2.8	6.0	4.5	4.8	3.5	3.5	6.9	6.4	3.8	4.9	5.1	5.1	4.2
10.0	10.0	8.9	6.3	8.9	10.0	4.4	6.7	10.0	10.0	6.2	4.1	10.0	3.1	10.0	2.2	4.1	6.3	4.9	10.0	8.0	4.7	9.2	10.0	10.0	7.6
1.3	.9	1.2	10.0	10.0	4.4	8.4	10.0	10.0	6.1	9.8	5.7	10.0	4.1	1.4	.9	1.4	.9	8.2	2.7	1.5	7.1	4.7	6.1	4.4	4.1
.5	.5	.5	.5	.5	.5	1.0	.5	.5	.5	.5	1.0	.5	4.8	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
.4	.5	.4	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.4	.5	.5	.5	.5	.5	.5	.5	.5
8.2	6.8	4.2	4.9	5.8	6.8	3.8	6.1	6.0	6.0	4.4	3.6	6.8	3.1	5.2	5.6	6.2	6.0	4.2	7.8	8.7	4.5	6.8	8.0	6.0	5.0
10.0	6.7	7.0	7.5	10.0	10.0	5.2	7.8	10.0	10.0	7.2	4.9	10.0	3.7	10.0	2.2	3.8	3.2	6.7	10.0	9.5	5.6	10.0	10.0	10.0	9.0
1.1	1.1	2.2	10.0	10.0	8.2	6.4	10.0	10.0	10.0	10.0	6.7	10.0	4.9	1.1	1.1	1.1	1.1	10.0	3.2	1.8	9.3	5.0	5.9	5.2	4.8
.8	.6	.5	.6	.6	.8	1.2	.6	.6	.6	.6	1.2	.6	6.2	.6	.5	.6	.5	.6	.6	.6	.6	.6	.6	.6	.6
.8	.6	.5	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.5	.6	.6	.6	.6	.6	.6	.6	.6

	BLU-27-F				SUU-30			BLU 27-U				SUU-64				A10 TANK				F15 TANK				SUM
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
1.4	1.8	1.7	2.2	1.8	1.7	2.2	1.4	1.4	1.5	1.2	1.4	1.4	2.2	2.6	1.4	1.7	1.7	1.7	1.7	1.8	1.9	1.7	1.8	107.2
1.8	3.8	5.0	8.8	3.1	3.0	10.0	2.4	2.3	1.6	2.2	1.5	2.2	5.0	6.3	2.3	2.8	3.8	3.8	2.4	2.2	2.2	3.3	2.2	177.8
2.7	10.0	10.0	10.0	8.1	10.0	10.0	10.0	5.3	2.2	3.8	2.0	3.3	10.0	6.1	3.1	6.1	10.0	10.0	4.3	3.4	4.1	10.0	3.4	270.7
3.9	10.0	2.9	2.9	10.0	10.0	2.8	5.4	3.1	3.5	2.4	3.8	8.1	4.0	2.5	5.3	3.8	3.3	2.8	8.8	8.2	10.0	3.8	7.6	235.1
5.5	1.6	1.3	1.3	1.8	6.2	1.3	5.3	1.3	2.2	1.3	2.4	1.7	1.9	1.3	8.1	1.8	1.3	1.3	1.5	2.0	2.0	1.7	2.0	132.2
1.8	2.3	2.2	2.8	2.3	2.2	2.7	1.8	1.8	1.8	2.1	2.1	1.8	2.7	3.2	1.8	2.2	2.2	2.2	2.2	2.3	2.4	2.2	2.3	138.3
2.3	4.4	6.2	8.9	3.9	4.4	10.0	3.0	2.8	2.6	2.8	1.7	2.7	5.8	8.5	2.8	3.6	4.8	4.8	3.1	2.8	2.8	4.2	2.8	203.2
3.3	10.0	10.0	10.0	8.7	10.0	10.0	10.0	7.7	3.2	8.4	3.0	4.8	10.0	7.5	3.9	8.4	10.0	10.0	6.8	4.9	6.1	10.0	5.0	307.7
4.9	10.0	3.7	3.7	10.0	10.0	3.7	10.0	3.5	4.8	3.1	4.8	8.5	4.2	3.2	7.2	4.4	3.7	3.7	7.1	10.0	10.0	4.8	10.0	288.8
5.8	2.1	1.7	1.7	2.1	10.0	1.7	7.3	1.7	2.7	1.7	2.7	2.3	2.4	1.7	3.8	2.1	1.7	1.7	2.1	2.8	2.8	2.2	2.8	183.4
2.2	2.8	2.7	3.3	2.8	2.8	3.3	2.2	2.8	2.8	2.4	2.3	2.2	3.2	3.8	2.2	2.7	2.7	2.7	2.7	2.8	2.9	2.7	2.8	168.8
2.8	5.4	7.4	9.7	4.7	5.3	10.0	3.8	4.1	2.1	3.2	2.8	3.3	6.7	8.8	3.5	4.4	5.8	5.8	3.8	3.4	3.4	5.1	3.4	230.3
4.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.9	7.0	3.8	5.8	10.0	8.5	5.5	10.0	10.0	10.0	8.7	8.9	8.1	10.0	5.9	333.8
5.9	10.0	4.5	4.4	10.0	10.0	4.5	10.0	4.3	6.8	3.7	6.0	10.0	5.0	3.8	9.4	5.4	4.5	4.5	7.5	10.0	10.0	8.6	10.0	287.0
8.6	2.6	2.1	2.1	2.6	10.0	2.1	10.0	2.1	2.8	2.1	3.2	2.9	2.9	2.1	4.0	2.6	2.1	2.1	2.8	3.2	3.2	2.7	3.2	176.5
2.8	3.3	3.3	4.0	3.3	3.3	3.9	3.4	2.8	2.8	2.8	3.0	2.6	3.7	4.3	2.8	3.2	3.2	3.2	3.2	3.3	3.3	3.2	3.3	174.7
3.3	8.2	8.6	10.[illegible]	5.5	6.[illegible]	10.0	5.0	4.0	2.6	3.5	2.4	3.9	7.5	10.0	4.1	8.2	6.8	6.8	4.5	4.0	4.8	6.8	4.0	284.9
4.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	4.4	7.8	4.1	6.8	10.0	10.0	6.4	10.0	10.0	10.0	8.7	8.9	7.1	10.0	6.9	384.0
7.7	10.0	9.2	9.2	10.0	10.0	8.3	10.0	5.1	8.2	4.4	6.9	10.0	5.8	4.5	10.0	8.4	5.3	5.2	8.3	10.0	10.0	8.8	10.0	321.7
10.0	3.1	2.5	2.5	3.1	10.0	2.5	10.0	2.5	3.3	2.4	3.6	[illegible]	3.4	2.5	4.8	3.1	2.5	2.5	3.1	2.8	2.8	3.2	3.8	185.2
1.4	2.2	2.2	2.8	2.2	2.7	2.8	1.8	1.8	1.8	1.2	1.5	[illegible]	2.8	3.0	1.8	2.0	2.2	2.1	1.6	1.7	2.3	2.1	1.7	119.7
2.2	4.0	6.1	10.0	3.1	3.4	10.0	2.3	3.0	1.9	2.9	1.8	2.5	6.4	10.0	2.7	3.1	4.7	4.7	2.7	3.0	3.1	4.7	3.0	187.0
3.0	10.0	10.0	10.0	7.8	10.0	10.0	3.7	10.0	3.7	8.2	2.8	3.9	10.0	4.2	4.0	8.0	10.0	10.0	4.9	4.7	5.8	10.0	4.7	288.2
4.2	10.0	2.4	2.0	9.8	10.0	2.1	3.8	2.0	10.0	1.6	8.4	8.1	2.3	1.7	8.8	2.3	2.5	2.1	2.8	3.0	3.2	2.4	3.0	212.1
5.5	1.2	1.3	1.0	1.2	4.5	1.3	4.4	1.2	1.3	.8	1.3	1.1	1.4	1.0	1.5	1.3	1.3	1.3	1.2	1.3	1.3	1.3	1.3	88.2
1.8	2.8	2.7	3.3	2.3	2.2	3.3	2.3	2.3	1.8	2.0	1.7	2.2	3.3	3.7	2.3	2.8	2.7	2.7	2.1	2.8	2.8	3.2	2.8	135.8
2.8	5.1	7.5	10.0	4.6	3.7	10.0	2.9	3.8	2.5	3.7	2.9	3.2	7.4	10.0	3.4	4.0	5.9	5.8	3.5	3.8	3.8	5.8	3.8	233.5
3.8	10.0	10.0	10.0	9.0	10.0	10.0	4.8	10.0	4.8	7.7	3.3	5.0	10.0	5.2	5.0	10.0	10.0	10.0	6.8	6.8	6.7	10.0	6.5	331.8
5.3	10.0	3.1	2.6	10.0	10.0	3.2	5.5	2.6	8.3	2.1	8.2	8.6	2.9	2.1	7.8	3.0	3.2	2.7	3.3	3.9	3.8	3.1	3.8	238.8
8.9	1.6	1.7	1.3	1.8	6.5	1.7	5.8	1.8	1.8	1.2	1.7	1.5	1.8	1.3	2.0	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.7	124.8
2.2	3.4	3.3	4.0	2.8	2.7	4.0	2.8	2.7	3.0	3.0	2.8	2.7	3.9	4.4	2.8	3.2	3.3	3.3	2.6	3.4	3.4	3.9	3.4	181.6
3.4	8.0	8.9	10.0	5.4	4.5	10.0	3.4	4.8	2.7	4.2	2.7	3.8	8.4	10.0	4.1	4.9	7.1	7.1	4.3	4.8	4.7	7.1	4.8	260.2
4.6	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.4	8.7	4.7	6.1	10.0	6.3	5.9	10.0	10.0	10.0	8.4	7.7	8.8	10.0	7.7	359.9
6.4	10.0	3.8	3.2	10.0	10.0	3.9	8.3	3.1	8.0	2.8	10.0	10.0	3.5	2.6	10.0	3.7	3.9	3.2	4.1	4.2	4.4	3.8	4.3	287.6
9.7	2.0	2.1	1.8	2.0	10.0	2.1	7.6	1.5	2.0	1.5	2.0	1.9	2.2	1.5	2.5	2.1	2.1	2.1	2.0	2.1	2.1	2.1	2.1	148.9
3.3	4.0	3.9	4.8	3.2	3.2	4.6	3.3	3.3	3.3	3.5	3.1	3.2	4.5	5.1	3.3	3.8	3.9	3.9	3.1	4.0	4.0	4.8	4.0	187.1
4.0	7.0	10.0	10.0	6.3	5.3	10.0	4.0	5.4	4.0	5.0	3.9	4.5	9.4	10.0	4.8	6.6	8.3	8.3	5.1	6.4	5.8	8.2	5.4	284.5
5.4	10.0	10.0	10.0	10.0	10.0	10.0	8.3	10.0	5.8	10.0	5.4	8.0	10.0	7.4	6.9	10.0	10.0	10.0	10.0	9.9	10.0	10.0	9.9	378.8
8.3	10.0	4.5	3.8	10.0	10.0	4.8	10.0	3.7	6.1	3.1	10.0	10.0	4.1	3.1	10.0	4.4	3.8	3.8	4.9	5.0	5.2	4.5	5.1	288.7
[illegible]	2.4	2.5	.9	2.4	10.0	2.5	9.8	1.8	2.3	1.8	2.1	2.2	2.8	.8	3.0	2.4	2.8	2.5	2.4	2.5	2.8	2.5	2.5	164.2
1.7	2.8	2.8	3.0	2.2	2.0	3.3	1.8	2.2	2.0	2.0	1.8	2.1	3.3	4.1	1.7	2.4	2.3	2.8	2.0	2.8	2.8	2.8	2.8	128.4
2.1	4.4	7.2	10.0	3.4	2.8	10.0	2.7	3.4	3.2	3.8	2.7	2.7	7.7	10.0	2.5	3.9	8.7	5.7	3.0	3.8	3.8	8.1	3.8	211.9
2.9	10.0	10.0	9.3	8.2	4.4	10.0	3.0	10.0	4.7	3.5	3.4	3.9	9.2	2.7	4.1	10.0	10.0	10.0	8.9	5.9	5.4	8.9	8.3	268.7
4.0	2.8	1.6	1.8	8.1	5.2	1.7	3.8	1.6	1.7	1.2	2.0	4.9	1.8	1.3	5.7	1.8	1.7	1.7	1.5	1.8	1.6	1.7	1.6	117.9
5.0	.9	1.0	1.0	.9	4.3	1.0	3.8	.9	.8	.9	.8	.8	1.0	.9	.9	.9	1.0	1.0	.9	.9	.9	1.0	.9	77.7
2.2	3.3	3.2	3.8	2.8	2.6	3.8	2.3	2.7	2.3	2.5	2.2	2.6	4.0	4.9	2.2	3.1	3.2	3.2	2.6	3.2	3.3	3.7	3.2	162.8
2.7	5.5	8.7	10.0	4.3	3.6	10.0	3.4	4.8	3.5	4.8	2.7	1.5	8.8	10.0	3.2	5.0	7.1	7.1	4.4	4.7	8.6	7.8	4.7	248.0
3.7	10.0	10.0	10.0	8.4	5.8	10.0	3.8	10.0	6.1	4.4	4.4	6.7	10.0	3.5	5.2	10.0	10.0	10.0	9.4	6.4	6.2	7.8	6.8	301.8
8.8	10.0	2.2	2.1	10.0	7.3	2.2	4.7	2.0	2.1	1.8	2.2	8.8	2.3	1.7	7.8	2.1	2.2	2.2	2.0	2.1	2.1	2.2	2.1	184.2
2.0	1.2	1.3	1.3	1.2	8.7	1.3	4.7	1.2	1.1	1	1.1	1.1	1.3	1.2	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.3	1.2	88.4
2.7	3.8	3.8	4.8	3.3	3.2	4.8	2.8	3.3	2.8	2.8	2.8	3.2	4.6	5.8	2.7	3.8	3.8	3.8	3.2	3.9	4.0	4.8	3.8	178.8
3.3	6.5	10.0	10.0	5.2	4.4	10.0	4.1	5.9	4.1	5.4	4.0	4.3	10.0	10.0	3.9	8.1	8.5	8.4	5.4	8.4	8.8	9.8	6.4	280.9
5.1	10.0	10.0	10.0	10.0	10.0	10.0	4.5	10.0	6.8	4.9	8.2	6.9	10.0	4.6	6.3	10.0	10.0	10.0	10.0	7.1	8.8	8.8	7.2	330.0
6.8	4.4	2.7	2.6	10.0	10.0	2.7	5.6	2.1	2.4	2.0	2.7	10.0	2.8	2.0	10.0	2.6	2.7	2.7	2.5	2.6	2.6	2.8	2.6	178.4
2.0	1.6	1.6	1.6	1.6	8.8	1.6	5.7	1.5	1.3	1.0	1.4	1.4	1.6	1.5	.5	1.5	1.6	1.8	1.5	1.5	1.6	1.8	1.6	104.8
3.2	4.6	4.6	5.4	3.9	3.8	5.4	3.7	3.9	3.0	4.1	2.9	3.8	5.3	8.7	4.0	4.4	4.6	4.6	3.7	4.6	4.7	5.3	4.8	208.4
3.9	7.6	10.0	10.0	8.1	5.9	10.0	4.7	6.8	4.8	8.4	4.4	5.1	10.0	10.0	5.4	7.2	9.9	10.0	8.4	7.5	7.7	10.0	7.5	313.4
6.0	10.0	10.0	10.0	10.0	10.0	10.0	6.1	10.0	8.2	5.7	7.2	8.2	10.0	5.7	7.3	10.0	10.0	10.0	10.0	7.7	7.3	9.8	7.7	349.0
8.8	5.2	3.1	3.1	10.0	10.0	3.2	7.4	2.4	2.6	2.4	3.1	9.4	3.3	2.4	10.0	3.1	3.2	3.2	3.0	3.1	3.1	3.1	3.1	204.7
2.4	1.8	1.8	1.8	1.8	10.0	1.9	6.7	1.8	1.3	1.2	1.8	[illegible]	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	120.0
1.7	2.4	3.0	3.4	2.5	2.0	3.4	1.7	2.8	2.8	2.4	2.4	1.8	3.8	5.1	2.1	2.7	2.8	2.8	2.3	3.5	3.5	3.3	3.3	132.3
2.5	4.0	8.2	10.0	3.7	3.2	10.0	2.8	4.2	3.8	4.8	2.5	2.9	9.8	9.2	2.8	4.7	8.8	7.2	3.7	6.4	8.8	8.8	6.9	231.2
3.2	8.1	10.0	5.9	5.3	4.2	10.0	2.8	4.2	2.5	1.8	8.1	4.1	4.1	1.9	4.2	7.5	8.8	6.1	9.9	1.9	2.0	3.6	2.2	217.8
4.2	1.2	1.0	1.0	1.8	3.5	1.0	2.9	.9	.9	.9	.9	1.1	1.0	.9	5.4	.9	1.0	1.0	.9	.9	.9	1.0	.9	78.8
.8	.6	.6	.6	.6	.8	.6	2.8	.8	.8	.8	.5	.6	.6	.6	.8	.6	.8	.6	.8	.8	.8	.6	.8	28.0
2.2	3.1	3.7	4.3	3.1	2.6	4.3	2.2	3.2	3.1	2.9	3.2	2.5	4.6	8.1	2.7	3.5	3.7	3.7	3.0	4.2	4.4	4.7	4.2	180.3
3.2	5.[illegible]	9.1	10.0	4.6	4.0	10.0	3.2	6.8	4.3	6.7	3.8	3.8	10.0	10.0	3.6	6.0	8.3	8.8	4.8	7.8	9.0	10.0	7.9	289.7
4.1	10.0	10.0	7.9	6.7	5.4	10.0	3.6	3.9	2.7	2.1	10.0	5.5	5.0	2.5	5.3	6.4	6.2	6.9	9.4	2.5	2.6	4.6	2.5	250.0
5.3	1.6	1.3	1.3	2.0	5.2	1.3	3.8	1.2	1.0	1.1	1.1	1.5	1.3	1.2	8.1	1.2	1.3	1.3	1.2	1.2	1.2	1.3	1.2	87.8
.8	.8	.8	.6	.8	.8	.8	3.9	.6	.6	.7	[illegible]	.8	.8	.6	.8	.8	.8	.8	.8	.8	.8	.8	.8	57.7
2.7	3.8	4.8	5.2	3.8	3.2	5.2	2.7	3.9	3.5	4.2	3.5	3.1	5.3	7.2	3.3	4.3	4.5	4.5	3.7	5.1	5.2	5.7	6.1	188.8
3.8	8.1	10.0	10.0	5.8	4.3	10.0	3.9	7.1	4.7	7.9	4.7	4.7	10.0	10.0	4.4	7.3	10.0	10.0	6.5	10.0	10.0	10.0	10.0	301.8
4.9	10.0	10.0	10.0	9.0	6.8	10.0	4.4	4.1	3.2	2.8	4.8	7.5	5.9	3.1	6.5	9.0	9.8	8.3	9.7	3.1	3.2	8.8	3.1	273.8
7.1	2.0	1.5	1.8	2.8	6.5	1.6	4.6	1.5	1.2	1.4	1.3	1.8	1.6	1.5	10.0	1.5	1.6	1.6	1.6	1.5	1.6	1.6	1.5	116.4
1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.9	1.0	.8	.8	.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	87.1
3.2	4.5	5.3	6.1	4.5	3.8	6.1	3.2	4.8	3.9	4.8	3.8	4.4	6.1	8.3	3.8	8.1	8.3	5.3	4.4	6.0	8.1	8.7	6.0	219.7
4.5	7.2	10.0	10.0	8.8	5.1	10.0	4.8	9.0	5.4	10.0	8.4	5.6	10.0	10.0	5.1	9.4	10.0	10.0	7.7	10.0	10.0	10.0	10.0	326.0
5.8	10.0	10.0	10.0	10.0	7.7	10.0	5.1	4.2	3.7	3.0	8.8	9.8	6.9	3.6	8.5	9.8	10.0	9.7	10.0	3.7	3.8	5.9	3.7	287.8
9.2	2.4	1.8	1.8	3.0	7.0	1.9	5.5	1.7	1.2	1.2	1.5	2.3	1.9	1.8	10.0	1.8	1.9	1.8	1.8	1.8	1.8	1.8	1.8	131.4
1.8	1.2	1.2	1.2	1.2	1.2	1.2	5.8	1.2	1.0	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	78.3
2.1	2.8	3.4	3.8	2.4	1.8	3.8	2.1	2.8	2.8	3.1	2.8	2.1	5.0	8.7	2.4	3.1	3.3	3.3	2.8	4.1	4.3	4.1	4.1	144.7
2.4	4.2	8.2	10.0	3.5	2.8	10.0	1.9	5.8	3.5	3.8	4.0	2.8	10.0	4.7	3.0	5.8	8.4	8.9	4.4	4.0	3.8	10.0	4.0	228.5
3.5	7.7	10.0	3.8	5.7	3.1	10.0	2.8	1.2	.5	.3	.5	3.9	1.7	.9	4.0	2.8	3.3	2.8	2.8	.9	.8	1.8	.8	152.0
.8	.3	.3	.3	.3	.8	.3	2.8	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	25.4
.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.2	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	13.8
2.8	3.3	4.2	4.8	3.1	2.4	4.9	2.7	3.7	3.2	3.9	3.2	2.8	6.0	8.1	3.1	4.0	4.2	4.2	3.4	8.1	8.0	8.2	8.1	177.4
3.1	5.4	10.0	10.0	4.4	3.2	10.0	2.4	8.0	2.4	4.2	8.8	3.9	10.0	8.1	3.8	7.8	10.0	10.0	8.2	4.7	4.8	10.0	4.7	280.8
4.4	10.0	10.0	4.6	7.2	4.1	10.0	3.3	1.1	.7	1.1	.7	5.8	2.2	1.2	5.8	3.8	4.2	3.8	3.7	1.2	1.2	2.1	1.2	179.7
.8	.4	.4	.4	.4	.8	.4	3.7	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	52.5
.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.3	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	18.8
3.2	4.3	8.1	8.1	3.8	3.0	5.8	2.8	8.0	4.5	4.8	3.5	3.5	8.9	8.4	3.8	4.9	5.1	5.1	4.2	6.9	7.2	8.3	8.2	207.8
4.4	8.7	10.0	10.0	8.2	4.1	10.0	3.1	10.0	2.2	4.1	8.3	4.8	10.0	8.0	4.7	9.2	10.0	10.0	7.6	5.8	5.4	10.0	5.8	201.8
8.4	10.0	10.0	8.1	9.8	8.7	10.0	4.1	1.4	.9	1.4	.9	8.2	2.7	1.5	7.1	4.7	5.1	4.4	4.1	1.5	1.8	2.8	1.8	201.8
1.0	.5	.5	.5	.5	1.0	.5	4.8	.5	.8	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	57.7
.5	.5	.5	.5	.5	.8	.5	.8	.8	.4	.8	.4	.8	.5	.5	.5	.5	.5	.5	.5	.5	.6	.5	.6	23.4
3.8	8.1	8.0	8.0	4.4	3.8	6.8	3.1	5.2	5.8	8.2	8.0	4.2	7.8	8.7	4.5	8.8	8.0	8.0	5.0	8.1	8.3	7.4	8.1	241.0
8.2	7.8	10.0	10.0	7.2	4.9	10.0	3.7	10.0	2.2	3.8	3.2	6.7	10.0	8.5	5.8	10.0	10.0	10.0	9.0	6.9	6.4	10.0	8.9	308.8
8.4	10.0	10.0	10.0	10.0	8.7	10.0	4.9	1.1	1.1	1.1	1.1	10.0	3.2	1.8	9.3	5.0	5.8	5.2	4.8	1.8	1.8	3.1	1.8	224.1
1.2	.8	.8	.8	.6	1.2	.6	6.2	.5	.5	.6	.5	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	63.8
.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.7	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	20.2

TABLE 4. (Contd.)

EOS CONDITIONS INIT VEL	PITCH ANGLE	PITCH RATE	SUU-41 1	2	3	4	F15 TANK 5	6	7	8	SUU-42 9	10	11	M117 12	13	14	BLU-1 U 15	16	17	MK 20 18	19
15.0	-6.0	-4.0	1.1	2.1	2.2	1.3	2.3	2.4	3.0	1.8	3.7	10.0	10.0	8.1	7.2	2.3	1.8	1.9	1.4	1.6	2.0
15.0	-6.0	-3.0	1.4	2.1	2.0	1.2	2.1	2.3	2.8	1.8	10.0	10.0	10.0	9.0	7.8	8.8	2.1	2.4	2.1	2.0	2.5
15.0	-6.0	-2.0	1.3	2.8	2.5	1.1	2.0	3.4	3.4	2.8	10.0	10.0	10.0	10.0	8.1	9.6	2.1	3.4	2.2	2.7	1.7
15.0	-6.0	-1.0	1.5	3.8	3.5	1.4	1.8	3.2	4.1	2.5	10.0	10.0	10.0	10.0	10.0	10.0	2.9	5.9	2.5	3.5	5.8
15.0	-6.0	0	1.9	4.4	5.0	1.2	1.7	3.0	4.6	2.3	10.0	10.0	10.0	10.0	10.0	10.0	4.5	10.0	2.8	6.1	8.4
20.0	-6.0	-4.0	1.5	2.6	2.6	1.7	2.8	2.7	3.5	1.8	3.7	10.0	10.0	9.7	8.4	2.8	1.9	2.4	1.6	2.1	2.5
20.0	-6.0	-3.0	1.8	2.4	2.5	1.6	2.6	2.6	3.3	1.7	10.0	10.0	10.0	10.0	9.0	9.8	2.5	3.0	2.3	2.6	3.1
20.0	-6.0	-2.0	1.8	3.3	3.8	1.5	2.3	3.8	4.0	3.1	10.0	10.0	10.0	10.0	10.0	10.0	3.1	4.1	2.5	3.6	4.4
20.0	-6.0	-1.0	2.1	4.2	4.3	1.9	2.2	3.6	4.7	2.8	10.0	10.0	10.0	10.0	10.0	10.0	3.5	7.9	2.7	4.5	6.6
20.0	-6.0	0	2.7	5.0	6.9	2.2	2.1	3.4	5.3	2.6	10.0	10.0	10.0	10.0	10.0	10.0	6.0	10.0	3.5	7.1	10.0
25.0	-6.0	-4.0	1.9	2.9	3.1	2.1	2.9	3.1	4.0	2.1	4.3	10.0	10.0	10.0	10.0	3.8	2.4	2.9	1.9	2.6	3.0
25.0	-6.0	-3.0	2.4	3.9	3.0	2.0	2.8	4.4	4.9	3.6	10.0	10.0	10.0	10.0	10.0	10.0	3.1	3.5	2.6	3.2	3.7
25.0	-6.0	-2.0	2.3	3.8	4.5	1.9	2.7	4.2	4.6	3.3	10.0	10.0	10.0	10.0	10.0	10.0	3.7	5.6	2.7	4.3	5.2
25.0	-6.0	-1.0	2.7	4.7	5.0	2.4	2.5	4.0	5.3	3.2	10.0	10.0	10.0	10.0	10.0	10.0	4.9	10.0	3.3	6.1	7.7
25.0	-6.0	0	3.6	5.8	7.9	2.6	3.7	5.3	6.9	2.9	10.0	10.0	10.0	10.0	10.0	10.0	7.9	10.0	4.1	8.6	10.0
30.0	-6.0	-4.0	2.3	3.3	3.6	2.5	3.2	3.4	4.5	2.3	5.0	10.0	10.0	10.0	10.0	3.8	2.8	3.3	3.0	3.1	3.5
30.0	-6.0	-3.0	2.9	4.4	3.5	2.4	3.1	4.8	5.4	1.8	10.0	10.0	10.0	10.0	10.0	10.0	1.5	4.1	3.2	3.8	4.3
30.0	-6.0	-2.0	3.5	4.2	5.2	2.3	3.0	4.6	6.3	1.7	10.0	10.0	10.0	10.0	10.0	10.0	4.2	6.5	3.0	5.1	6.0
30.0	-6.0	-1.0	3.9	5.3	5.8	2.9	2.9	4.4	7.1	1.5	10.0	10.0	10.0	10.0	10.0	10.0	5.6	10.0	4.0	7.2	8.7
30.0	-6.0	0	4.3	6.3	9.0	3.4	4.1	5.7	7.7	1.2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	4.4	10.0	10.0
15.0	-4.0	-4.0	[illegible]	[illegible]	2.0	1.2	1.7	3.0	3.3	2.1	3.5	10.0	10.0	2.8	7.8	1.8	[illegible]	2.3	2.0	2.0	[illegible]
15.0	-4.0	-3.0	1.3	2.8	2.5	1.1	1.6	2.8	3.9	2.2	10.0	10.0	10.0	8.4	8.3	2.1	1.9	2.8	2.2	2.4	3.1
15.0	-4.0	-2.0	1.6	3.7	3.0	1.4	2.5	3.9	4.4	2.0	10.0	10.0	10.0	9.3	10.0	2.7	2.4	3.9	1.8	2.7	4.3
15.0	-4.0	-1.0	1.7	4.5	3.9	1.3	2.3	3.5	4.6	1.8	10.0	10.0	10.0	10.0	10.0	10.0	3.2	7.6	2.1	3.8	5.5
15.0	-4.0	0	1.7	5.2	6.4	1.4	2.1	4.4	6.2	2.9	10.0	10.0	10.0	10.0	10.0	10.0	8.6	8.1	3.2	5.4	9.0
20.0	-4.0	-4.0	1.5	2.4	2.5	1.8	2.1	3.4	3.8	2.6	4.3	10.0	10.0	2.7	9.2	2.0	1.9	3.0	2.2	2.6	3.1
20.0	-4.0	-3.0	1.8	3.3	3.1	1.5	3.2	4.7	4.5	2.4	10.0	10.0	10.0	10.0	9.7	2.8	2.5	3.6	2.5	3.1	3.8
20.0	-4.0	-2.0	2.2	4.2	3.6	1.8	2.9	4.3	5.0	2.3	10.0	10.0	10.0	10.0	10.0	10.0	3.1	4.6	2.8	3.5	5.1
20.0	-4.0	-1.0	2.4	5.1	4.7	1.7	2.7	5.5	6.2	1.6	10.0	10.0	10.0	10.0	10.0	10.0	4.6	9.8	3.2	4.9	7.4
20.0	-4.0	0	2.5	5.9	8.6	2.0	2.4	4.8	9.4	1.2	10.0	10.0	10.0	10.0	10.0	10.0	7.5	9.7	3.6	6.9	10.0
25.0	-4.0	-4.0	1.9	2.8	3.0	2.0	2.4	3.8	5.4	2.8	8.0	10.0	10.0	3.3	10.0	2.4	3.0	3.6	2.5	3.2	3.7
25.0	-4.0	-3.0	2.3	3.8	3.7	1.9	3.8	5.0	8.1	2.7	10.0	10.0	10.0	10.0	10.0	3.1	3.0	4.2	[illegible]	3.8	4.4
25.0	-4.0	-2.0	2.7	4.8	4.3	2.4	3.3	4.7	6.6	2.6	10.0	10.0	10.0	10.0	10.0	10.0	4.2	5.5	3.1	4.9	6.0
25.0	-4.0	-1.0	3.1	5.7	6.5	2.2	3.0	5.8	8.8	1.9	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	4.0	6.1	8.5
25.0	-4.0	0	3.3	6.6	9.8	2.6	4.1	6.7	10.0	1.6	10.0	10.0	10.0	10.0	10.0	10.0	8.7	10.0	4.7	9.1	10.0
30.0	-4.0	-4.0	2.9	3.2	3.5	2.4	4.1	5.7	6.0	1.2	5.8	10.0	10.0	3.9	10.0	2.8	3.4	4.1	2.8	3.6	4.3
30.0	-4.0	-3.0	2.8	4.2	4.2	2.3	3.8	5.4	6.7	1.1	10.0	10.0	10.0	10.0	10.0	3.6	3.4	4.8	3.0	4.4	5.1
30.0	-4.0	-2.0	3.3	5.3	4.9	2.9	3.6	6.8	8.3	4.8	10.0	10.0	10.0	10.0	10.0	10.0	4.8	7.2	3.9	5.8	6.8
30.0	-4.0	-1.0	3.8	6.4	7.4	2.7	3.4	8.1	10.0	4.2	10.0	10.0	10.0	10.0	10.0	10.0	6.4	10.0	4.4	7.1	9.6
30.0	-4.0	0	4.7	7.2	10.0	3.2	4.4	7.0	8.1	1.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	5.1	[illegible]	10.0
15.0	-2.0	-4.0	1.3	2.9	1.9	[illegible]	2.0	4.3	4.8	[illegible]	4.0	10.0	[illegible]	2.1	7.8	[illegible]	2.0	2.5	[illegible]	[illegible]	2.5
15.0	-2.0	-3.0	1.3	2.7	2.4	1.0	2.9	5.2	5.8	2.4	10.0	10.0	10.0	8.3	9.0	2.1	2.4	2.8	[illegible]	2.1	3.0
15.0	-2.0	-2.0	1.4	3.5	3.4	1.3	2.5	5.8	7.9	2.2	10.0	10.0	10.0	9.3	10.0	2.0	2.8	4.3	2.5	3.1	4.2
15.0	-2.0	-1.0	1.5	4.2	4.9	1.5	2.1	7.9	3.8	1.2	10.0	10.0	10.0	0.0	10.0	2.6	4.2	10.0	2.9	4.2	6.1
15.0	-2.0	0	1.7	5.9	10.0	1.2	2.8	4.1	2.6	2.6	10.0	10.0	10.0	10.0	10.0	3.1	7.0	6.4	3.3	5.7	[illegible]
20.0	-2.0	-4.0	1.8	3.3	2.4	1.5	2.4	4.8	6.4	2.9	4.9	10.0	10.0	2.7	9.9	[illegible]	2.4	2.9	2.5	2.6	[illegible]
20.0	-2.0	-3.0	1.8	3.2	2.9	1.4	3.2	5.4	8.1	2.7	10.0	10.0	10.0	10.0	10.0	2.6	2.9	4.0	2.1	3.0	3.7
20.0	-2.0	-2.0	2.0	4.0	4.1	1.7	2.9	7.0	7.0	[illegible]	10.0	10.0	10.0	10.0	10.0	2.9	3.4	5.7	2.8	1.9	5.1
20.0	-2.0	-1.0	2.2	4.8	5.9	2.1	3.6	6.6	4.0	3.4	10.0	10.0	10.0	10.0	10.0	[illegible]	5.0	10.0	3.4	5.4	[illegible]
20.0	-2.0	0	2.8	8.7	10.0	1.8	3.0	3.8	3.1	2.9	10.0	10.0	10.0	10.0	10.0	[illegible]	[illegible]	[illegible]	3.5	7.3	10.0
25.0	-2.0	-4.0	2.3	3.8	2.9	1.9	3.9	6.4	6.0	3.2	4.9	10.0	10.0	3.3	10.0	2.3	2.9	3.9	2.8	3.2	[illegible]
25.0	-2.0	-3.0	2.2	3.7	4.4	1.8	3.8	7.0	10.0	1.0	10.0	10.0	10.0	10.0	10.0	3.1	3.8	4.1	2.5	3.7	4.4
25.0	-2.0	-2.0	2.8	4.8	4.9	2.2	3.3	10.0	8.1	4.2	10.0	10.0	10.0	10.0	10.0	3.8	4.2	7.0	3.2	4.9	[illegible]
25.0	-2.0	-1.0	3.4	5.5	6.9	2.7	3.9	5.8	4.4	1.7	10.0	10.0	10.0	10.0	10.0	3.7	5.9	10.0	3.8	6.6	9.3
25.0	-2.0	0	3.5	7.4	10.0	2.4	4.4	3.8	3.4	4.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.5	5.1	9.7	10.0
30.0	-2.0	-4.0	2.6	4.2	3.4	2.3	4.3	8.1	10.0	3.8	5.6	10.0	10.0	3.9	10.0	2.7	3.3	4.0	3.1	1.8	4.3
30.0	-2.0	-3.0	3.4	4.1	5.1	2.9	4.0	9.9	10.0	4.8	10.0	10.0	10.0	10.0	10.0	3.5	4.1	5.6	3.6	4.4	5.1
30.0	-2.0	-2.0	3.2	5.1	5.7	2.7	4.9	8.5	5.9	4.4	10.0	10.0	10.0	10.0	10.0	4.4	6.6	8.0	3.5	5.7	6.8
30.0	-2.0	-1.0	4.2	6.1	7.9	3.2	5.6	5.2	4.6	5.6	10.0	10.0	10.0	10.0	10.0	10.0	7.7	10.0	4.2	7.8	10.0
30.0	-2.0	0	4.4	8.3	10.0	3.8	6.0	4.3	4.0	[illegible]	10.0	10.0	10.0	10.0	10.0	10.0	10.0	[illegible]	[illegible]	10.0	10.0
15.0	-1.0	-4.0	1.3	2.8	2.5	1.0	2.3	6.4	6.0	[illegible]	5.9	10.0	10.0	2.1	7.8	1.8	1.9	2.3	1.9	2.0	2.5
15.0	-1.0	-3.0	1.5	2.7	2.9	1.3	2.1	9.1	6.4	2.8	10.0	10.0	10.0	8.3	9.0	2.0	2.4	3.2	2.3	2.3	3.0
15.0	-1.0	-2.0	1.4	3.4	3.2	1.2	2.6	3.8	3.1	2.3	10.0	10.0	10.0	9.3	10.0	2.0	2.8	4.8	2.1	3.0	4.2
15.0	-1.0	-1.0	1.7	5.2	8.3	1.4	2.9	2.5	2.3	3.0	10.0	10.0	10.0	9.8	10.0	2.8	4.0	10.0	2.5	[illegible]	6.8
15.0	-1.0	0	1.6	6.8	5.1	1.1	2.9	2.0	1.9	3.4	10.0	10.0	10.0	10.0	10.0	2.4	8.5	5.8	3.4	5.6	10.0
20.0	-1.0	-4.0	1.8	3.2	3.1	1.4	2.7	7.8	9.0	1.4	4.8	10.0	10.0	2.7	9.9	1.8	2.3	2.9	2.2	2.6	3.1
20.0	-1.0	-3.0	2.1	3.1	3.6	1.8	3.4	5.8	5.4	1.0	10.0	10.0	10.0	10.0	10.0	2.8	2.9	4.1	2.7	3.0	4.4
20.0	-1.0	-2.0	2.0	3.9	4.8	1.7	2.9	3.7	3.5	3.9	10.0	10.0	10.0	10.0	10.0	2.5	4.0	5.8	2.5	3.9	5.8
20.0	-1.0	-1.0	2.5	5.9	6.4	2.0	3.2	3.0	2.7	3.2	10.0	10.0	10.0	10.0	10.0	3.1	5.8	10.0	3.7	5.4	8.0
20.0	-1.0	0	2.5	7.6	8.0	2.1	3.8	2.4	2.3	1.3	10.0	10.0	10.0	10.0	10.0	3.0	10.0	7.1	4.4	7.8	10.0
25.0	-1.0	-4.0	2.3	3.7	3.7	1.8	4.4	10.0	10.0	1.7	5.8	10.0	10.0	3.2	10.0	2.3	3.0	3.4	2.5	3.2	3.7
25.0	-1.0	-3.0	2.7	4.7	4.3	2.3	3.8	8.2	5.4	4.9	10.0	10.0	10.0	10.0	10.0	3.0	3.8	4.8	3.0	3.7	5.2
25.0	-1.0	-2.0	3.1	4.5	5.6	2.2	4.3	3.8	3.9	4.1	10.0	10.0	10.0	10.0	10.0	2.9	4.7	6.9	3.7	4.8	[illegible]
25.0	-1.0	-1.0	3.3	6.6	7.5	2.8	4.4	3.1	3.3	4.8	10.0	10.0	10.0	10.0	10.0	3.7	6.6	10.0	3.7	6.6	9.2
25.0	-1.0	0	3.8	8.4	6.8	2.8	6.3	2.6	2.8	5.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.7	4.9	10.0	10.0
30.0	-1.0	-4.0	2.8	4.2	4.2	2.2	4.7	7.7	8.0	4.1	6.8	10.0	10.0	3.8	10.0	2.7	3.5	4.1	2.9	3.8	4.2
30.0	-1.0	-3.0	3.3	5.3	4.9	2.8	5.5	6.2	5.3	5.1	10.0	10.0	10.0	10.0	10.0	3.8	4.2	5.6	3.8	4.4	5.9
30.0	-1.0	-2.0	3.8	8.3	6.5	2.7	5.9	4.3	4.6	5.9	10.0	10.0	10.0	10.0	10.0	3.4	8.6	8.8	3.5	5.7	7.7
30.0	-1.0	-1.0	4.1	7.2	9.8	3.1	8.4	3.6	3.4	8.0	10.0	10.0	10.0	10.0	10.0	4.3	7.7	10.0	5.1	8.5	10.0
30.0	-1.0	0	4.8	9.2	2.4	3.5	4.4	2.0	2.2	4.2	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.2	6.4	10.0	10.0
15.0	0	-4.0	1.3	2.7	2.4	1.0	2.6	3.5	4.6	3.2	3.8	10.0	10.0	2.0	8.5	1.5	2.0	2.3	1.7	1.9	2.5
15.0	0	-3.0	1.5	3.8	2.8	1.3	2.6	2.5	2.9	2.8	10.0	10.0	10.0	8.3	9.7	2.0	2.4	3.3	2.0	2.7	3.6
15.0	0	-2.0	1.6	4.3	3.8	1.1	2.8	2.0	2.2	2.8	10.0	10.0	10.0	9.2	10.0	1.8	3.1	4.7	2.1	3.0	4.8
15.0	0	-1.0	1.6	5.0	5.6	1.3	2.7	1.6	1.7	3.8	10.0	10.0	10.0	9.5	10.0	2.8	4.4	10.0	3.1	4.1	6.7
15.0	0	0	1.7	6.5	3.4	1.3	4	1.5	1.6	2	10.0	10.0	10.0	9.8	10.0	2.4	8.5	5.3	3.3	6.0	10.0
20.0	0	-4.0	1.8	3.2	3.0	1.4	2.8	3.7	4.8	3.4	4.7	10.0	10.0	2.6	9.8	1.8	2.8	2.9	2.0	2.5	3.1
20.0	0	-3.0	2.1	4.1	3.5	1.8	3.1	3.0	3.4	4.0	10.0	10.0	10.0	10.0	10.0	2.8	3.0	4.0	2.8	3.5	4.4
20.0	0	-2.0	2.3	4.9	4.6	1.8	3.8	2.4	2.6	4.0	10.0	10.0	10.0	10.0	10.0	2.4	3.9	6.5	3.2	4.4	5.7
20.0	0	-1.0	2.4	5.7	6.8	1.9	3.5	2.0	2.2	4.4	10.0	10.0	10.0	10.0	10.0	3.1	6.5	10.0	3.6	5.3	7.8
20.0	0	0	2.7	8.6	4.5	2.0	1.4	1.6	1.6	1.6	10.0	10.0	10.0	10.0	10.0	3.0	10.0	5.9	4.6	7.7	10.0
25.0	0	-4.0	2.3	3.7	3.6	1.8	4.3	3.8	4.9	5.3	5.8	10.0	10.0	3.2	10.0	2.3	2.9	3.5	2.4	3.1	3.7
25.0	0	-3.0	2.7	4.6	4.2	2.2	4.4	3.1	3.8	4.1	10.0	10.0	10.0	10.0	10.0	3.0	3.5	4.8	3.8	4.3	5.1
25.0	0	-2.0	3.0	5.6	3.5	2.1	4.5	2.5	3.2	4.8	10.0	10.0	10.0	10.0	10.0	2.9	4.7	7.8	3.8	5.4	6.7
25.0	0	-1.0	3.2	8.4	6.9	2.4	2.5	2.4	2.8	2.8	10.0	10.0	10.0	10.0	10.0	3.7	7.3	10.0	4.4	7.2	10.0
25.0	0	0	3.7	9.3	5.1	2.7	2.0	2.0	2.3	2.0	10.0	10.0	10.0	10.0	10.0	3.8	10.0	6.4	5.6	10.0	10.0
30.0	0	-4.0	2.8	4.1	4.1	2.2	5.8	4.3	8.2	5.3	8.4	10.0	10.0	3.8	10.0	2.7	3.3	4.8	3.6	3.7	4.2
30.0	0	-3.0	3.3	6.2	4.8	2.7	5.6	3.8	4.0	5.4	10.0	10.0	10.0	10.0	10.0	3.8	4.8	5.6	3.9	5.1	5.9
30.0	0	-2.0	3.7	8.2	6.3	2.6	8.3	3.0	3.4	6.6	10.0	10.0	10.0	10.0	10.0	3.4	8.8	8.8	4.5	6.4	7.6
30.0	0	-1.0	4.0	7.1	10.0	3.0	3.0	2.8	2.8	1.0	10.0	10.0	10.0	10.0	10.0	4.2	8.4	10.0	5.4	8.5	10.0
30.0	0	0	4.7	10.0	6.0	3.3	2.4	2.3	2.8	2.4	10.0	10.0	10.0	10.0	10.0	4.1	10.0	7.3	8.7	10.0	10.0

BLU-1 U			MK 20				BLU-27 F				SUU 30			BLU-27 U				SUU-64				A10 TANK			
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1.8	1.9	1.4	1.6	2.0	2.1	1.4	1.7	2.2	2.2	1.8	1.7	2.2	1.9	1.9	1.5	1.8	1.6	1.8	2.9	3.1	1.9	1.8	2.1	2.1	1.8
2.1	2.4	2.1	2.5	2.5	3.0	1.8	2.8	3.1	3.5	2.2	2.8	4.0	1.8	2.2	1.4	1.8	2.0	2.2	3.4	4.3	1.8	2.4	2.5	2.8	2.0
2.1	3.4	2.2	2.7	1.7	5.4	1.8	4.1	5.6	10.0	3.2	2.9	10.0	2.3	2.7	2.4	2.2	2.2	2.6	5.7	9.6	2.3	3.2	4.3	4.2	2.3
2.9	5.9	2.5	3.5	5.6	10.0	2.2	6.9	10.0	10.0	4.7	10.0	10.0	3.3	4.0	2.7	3.0	[illegible]	2.9	8.9	10.0	2.7	4.4	7.9	8.4	3.5
4.5	10.0	2.8	5.1	8.4	10.0	2.6	10.0	10.0	10.0	7.9	10.0	10.0	3.8	7.7	2.4	7.1	2.3	3.6	10.0	4.8	3.6	7.1	10.0	10.0	4.8
1.9	2.4	1.6	2.1	2.5	2.7	1.8	2.2	2.8	2.8	2.3	2.2	2.7	2.4	2.3	1.9	2.0	1.8	2.3	3.4	3.8	2.4	2.1	2.7	2.7	2.1
2.5	3.0	2.3	2.6	3.1	3.8	2.3	3.4	3.8	4.4	2.8	2.7	4.4	2.4	2.8	2.0	2.8	1.8	2.8	4.1	5.2	2.3	3.1	3.2	3.7	2.6
3.1	4.1	2.5	3.6	4.4	6.6	2.3	5.1	6.8	10.0	3.9	4.4	10.0	2.9	3.3	2.7	3.2	2.6	3.3	6.6	10.0	2.8	4.1	5.4	5.3	3.6
3.5	7.9	2.7	4.5	6.8	10.0	2.8	10.0	10.0	10.0	5.7	10.0	10.0	3.1	4.9	3.1	3.8	2.9	3.7	10.0	10.0	3.3	5.6	9.7	10.0	4.5
8.0	10.0	3.5	7.1	10.0	10.0	3.3	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	3.7	10.0	2.7	4.6	10.0	6.0	4.4	9.5	10.0	10.0	5.9
2.4	2.9	1.9	2.6	3.0	3.3	2.2	2.7	3.4	3.3	2.8	2.7	3.3	2.8	2.8	2.2	2.4	2.1	2.8	4.0	4.5	2.9	2.8	3.3	3.3	2.6
3.1	3.5	2.6	3.2	3.7	4.8	2.8	4.1	4.6	5.3	3.4	3.3	5.3	2.8	3.4	2.1	3.0	2.0	3.4	4.8	6.0	2.8	3.8	3.9	4.5	3.2
3.7	5.6	2.7	4.3	5.2	7.9	3.4	6.1	[illegible]	10.0	4.7	5.3	10.0	4.3	4.0	3.1	3.8	2.9	3.9	7.6	10.0	3.4	5.0	8.4	6.4	4.3
4.9	10.0	3.3	6.1	7.7	10.0	3.4	10.0	10.0	10.0	6.9	10.0	10.0	4.9	5.9	2.7	4.9	2.6	4.5	10.0	10.0	4.8	6.8	10.0	10.0	6.5
7.9	10.0	4.1	8.6	10.0	10.0	4.7	10.0	10.0	10.0	10.0	10.0	10.0	6.4	10.0	3.4	10.0	3.3	6.4	10.0	7.8	5.3	10.0	10.0	10.0	7.9
2.8	3.3	3.0	3.1	3.5	3.9	2.6	4.0	4.0	3.9	3.3	3.2	3.9	3.3	3.3	2.4	2.8	2.3	3.3	4.6	5.2	3.4	3.1	3.9	3.8	3.1
1.5	4.1	3.2	3.8	4.3	5.3	3.3	[illegible]	5.4	5.4	4.0	3.9	6.1	3.3	4.0	3.3	1.8	3.2	4.0	5.5	6.9	3.3	4.8	4.6	5.3	3.8
4.2	6.5	3.0	5.1	[illegible]	9.2	4.0	7.1	9.4	10.0	5.5	6.1	10.0	5.0	5.4	3.8	4.3	3.5	4.6	8.5	10.0	4.0	5.9	7.5	7.5	5.1
5.6	10.0	4.0	7.2	8.7	10.0	4.0	10.0	10.0	10.0	7.9	10.0	10.0	5.7	7.7	4.1	5.7	3.9	5.3	10.0	10.0	5.8	8.0	10.0	10.0	6.5
10.0	10.0	4.4	10.0	10.0	10.0	5.5	10.0	10.0	10.0	10.0	10.0	10.0	[illegible]	10.0	[illegible]	10.0	4.3	[illegible]	10.0	[illegible]	[illegible]	10.0	10.0	10.0	[illegible]
1.8	2.3	2.0	2.0	[illegible]	[illegible]	1.4	2.2	2.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.8	1.8	[illegible]	[illegible]	[illegible]	2.8	3.5	1.8	2.0	2.1	2.1	1.6
1.9	2.8	2.2	2.4	3.1	3.4	1.8	2.6	3.5	3.5	2.8	2.6	3.9	1.8	2.2	2.4	2.0	2.2	2.1	4.1	5.6	2.3	2.4	2.8	2.9	2.4
2.4	3.9	1.8	2.7	4.3	6.4	2.2	4.0	6.1	10.0	3.1	3.4	10.0	2.3	3.0	1.9	2.5	1.8	2.5	6.4	10.0	2.7	3.1	4.7	4.7	2.7
3.2	7.6	2.1	3.8	5.5	10.0	2.8	7.6	10.0	10.0	4.8	4.9	10.0	2.7	4.3	2.7	3.7	2.6	3.3	10.0	9.1	3.1	4.8	8.1	10.0	3.4
8.6	8.1	3.2	5.4	9.0	10.0	3.0	10.0	10.0	10.0	7.5	10.0	10.0	3.7	10.0	3.7	6.2	2.6	3.9	10.0	4.2	4.0	8.0	10.0	10.0	4.9
1.9	3.0	2.2	2.6	3.1	3.2	1.8	2.8	2.7	3.3	2.3	2.2	3.3	2.3	2.3	1.8	2.0	[illegible]	2.2	3.3	3.7	2.3	2.8	2.7	2.7	2.1
2.5	3.6	2.5	3.1	3.8	4.3	2.3	3.3	4.4	4.4	3.4	3.3	5.6	2.1	2.8	2.7	2.8	2.5	2.7	4.9	6.7	2.9	3.1	3.7	3.7	3.1
3.1	4.6	2.8	3.5	5.1	7.9	2.8	5.1	7.5	10.0	4.6	3.7	10.0	2.9	3.9	2.5	3.7	2.9	3.2	7.4	10.0	3.4	4.0	5.9	5.9	3.5
4.6	9.8	3.2	4.9	7.4	10.0	3.3	9.1	10.0	10.0	5.7	6.0	10.0	3.3	5.4	2.9	5.1	2.8	4.1	10.0	10.0	3.9	6.1	10.0	10.0	5.0
7.6	9.7	3.6	6.9	10.0	10.0	3.8	10.0	10.0	10.0	9.0	10.0	10.0	4.8	10.0	4.8	7.7	3.3	5.0	10.0	5.2	5.0	10.0	10.0	10.0	8.8
3.0	3.6	2.5	3.2	3.7	3.9	2.2	3.4	3.3	4.0	2.8	2.7	4.0	2.8	2.7	3.0	3.0	2.8	2.7	3.9	4.4	2.8	3.2	3.3	3.3	2.8
3.0	4.2	[illegible]	3.8	4.4	5.2	2.8	4.0	5.3	5.3	[illegible]	3.9	5.9	3.5	3.4	3.4	3.0	3.2	3.3	5.6	6.7	3.5	3.8	4.5	4.5	3.8
4.2	5.5	3.1	4.9	6.0	8.8	3.4	6.0	8.9	10.0	5.4	4.5	10.0	3.4	4.6	2.7	4.2	2.7	3.8	8.4	10.0	4.1	4.9	7.1	7.1	4.3
5.4	10.0	4.0	6.1	8.5	10.0	4.0	10.0	10.0	10.0	7.6	7.2	10.0	4.9	7.2	4.2	6.1	3.2	5.0	10.0	10.0	4.7	7.4	10.0	10.0	6.1
9.7	10.0	4.7	9.1	10.0	10.0	4.6	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.4	8.7	4.7	6.1	10.0	6.3	5.9	10.0	10.0	10.0	8.4
3.4	4.1	2.8	3.8	4.3	4.8	3.3	4.0	3.9	4.8	3.2	3.2	4.6	3.1	3.3	3.3	3.8	3.1	3.2	4.5	5.1	3.3	3.8	3.8	3.9	3.1
3.4	4.8	3.0	4.4	5.1	6.1	3.3	4.7	6.1	6.1	4.7	4.6	6.9	[illegible]	4.0	3.8	3.5	3.4	3.9	6.4	7.7	4.1	4.5	5.3	5.3	4.4
4.8	7.2	3.9	5.8	6.8	10.0	4.0	7.0	10.0	10.0	6.3	5.3	10.0	4.0	5.4	4.0	5.0	3.9	4.5	9.4	10.0	4.8	6.6	8.3	8.3	5.1
8.4	10.0	4.4	7.1	9.6	10.0	4.7	10.0	10.0	10.0	8.7	10.0	10.0	5.6	8.3	4.0	7.9	3.6	5.9	10.0	10.0	5.4	9.5	10.0	10.0	7.1
10.0	[illegible]	5.1	[illegible]	[illegible]	10.0	5.4	10.0	10.0	10.0	10.0	10.0	10.0	6.1	10.0	5.8	10.0	3.4	[illegible]	10.0	7.4	6.0	10.0	10.0	10.0	10.0
2.0	2.1	1.8	2.0	2.5	2.5	1.8	2.2	[illegible]	2.8	2.2	2.1	[illegible]	[illegible]	[illegible]	2.4	2.1	[illegible]	[illegible]	1.4	3.5	1.8	2.0	2.5	2.5	2.0
2.4	2.8	2.2	2.3	3.0	3.9	1.7	3.1	3.5	3.9	2.8	2.4	4.4	2.3	2.6	1.9	2.4	1.8	2.0	4.0	6.1	2.2	2.7	3.3	3.3	2.3
2.8	4.3	2.5	3.1	4.2	7.0	2.2	3.9	6.6	10.0	3.5	3.4	10.0	2.2	1.5	3.2	2.8	2.6	2.8	7.0	10.0	2.6	3.5	5.2	5.2	3.1
4.2	10.0	2.9	4.2	6.1	10.0	2.6	7.3	10.0	10.0	4.4	3.6	10.0	2.7	4.7	3.6	5.0	3.0	3.1	10.0	6.8	3.0	5.2	10.0	10.0	3.8
7.0	6.4	1.3	5.7	[illegible]	9.5	2.9	10.0	10.0	10.0	6.8	5.1	10.0	3.7	10.0	4.4	4.7	3.0	4.2	10.0	3.6	3.8	10.0	10.0	10.0	[illegible]
2.4	2.9	2.5	2.6	3.1	3.2	2.3	2.7	3.3	3.3	2.8	2.7	3.2	2.3	2.3	2.7	2.5	2.5	2.2	4.1	4.3	2.3	2.6	3.2	3.2	2.6
2.9	4.0	2.1	3.0	3.7	4.9	2.2	3.8	4.4	4.9	3.3	3.2	5.5	2.8	3.3	2.2	3.1	2.2	2.6	4.7	7.3	2.8	3.5	4.2	4.2	3.0
3.4	5.2	2.8	1.9	5.1	8.5	[illegible]	4.9	8.1	10.0	4.4	4.2	10.0	2.8	4.3	3.4	4.1	3.3	2.6	8.1	10.0	3.3	4.5	6.5	6.5	4.0
5.0	10.0	3.4	5.4	7.2	10.0	3.2	8.8	10.0	10.0	6.1	8.0	10.0	3.8	6.5	3.8	6.7	3.8	4.0	10.0	9.0	3.8	7.2	10.0	10.0	6.4
8.4	7.8	3.5	7.3	10.0	10.0	3.7	10.0	10.0	[illegible]	8.5	10.0	10.0	4.5	10.0	8.1	8.8	4.4	7.4	10.0	4.5	4.7	10.0	10.0	10.0	7.9
2.8	3.5	2.8	3.2	3.7	3.9	2.8	3.3	4.0	3.9	3.3	3.3	4.8	2.9	3.4	3.4	2.9	3.2	2.7	4.7	5.1	2.8	3.2	3.8	3.8	3.2
3.8	4.1	2.5	3.7	4.4	5.8	2.7	4.6	6.2	5.9	4.0	3.8	8.8	3.4	4.0	2.8	3.6	2.8	3.2	6.9	8.5	3.4	4.3	6.1	6.1	3.7
4.2	7.0	3.2	4.9	5.9	10.0	3.3	5.9	9.6	10.0	5.3	5.1	10.0	3.4	5.2	3.7	4.9	3.6	4.4	9.2	10.0	4.0	5.5	7.8	7.7	4.9
5.8	10.0	3.8	6.6	9.3	10.0	3.9	10.0	10.0	10.0	7.4	7.1	10.0	4.0	7.7	4.1	8.8	4.3	5.6	10.0	10.0	4.5	8.7	10.0	10.0	6.8
10.0	8.5	5.1	9.7	10.0	10.0	4.6	10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.6	6.7	5.3	6.5	10.0	5.5	5.7	10.0	10.0	10.0	10.0
3.3	4.0	3.1	3.8	4.3	4.6	3.3	3.9	4.8	4.6	3.9	3.9	4.8	3.3	3.9	3.7	1.8	3.5	3.2	5.4	5.9	3.3	3.8	4.8	4.6	3.8
4.1	5.6	3.8	4.4	5.1	8.8	3.2	5.4	6.1	6.9	4.7	4.6	7.7	4.0	4.7	3.2	4.1	3.0	3.8	7.3	8.5	4.0	5.1	6.0	6.0	4.4
8.6	8.0	3.5	5.7	6.8	10.0	3.9	7.8	10.0	10.0	6.1	6.0	10.0	4.0	6.1	4.0	5.8	3.9	5.2	10.0	10.0	4.7	6.5	8.1	9.0	5.7
7.7	10.0	4.2	7.8	10.0	10.0	4.8	10.0	10.0	10.0	8.5	8.3	10.0	4.7	9.8	4.6	9.8	4.6	6.6	10.0	10.0	6.2	10.0	10.0	10.0	7.8
10.0	9.3	[illegible]	[illegible]	[illegible]	[illegible]	5.3	10.0	10.0	10.0	10.0	10.0	[illegible]	6.2	10.0	7.1	[illegible]	6.2	8.6	10.0	6.5	7.6	10.0	10.0	10.0	10.0
1.8	2.3	1.9	2.0	2.5	2.5	1.8	[illegible]	2.8	2.8	2.1	2.1	3.0	1.8	2.2	2.4	1.8	2.2	2.1	3.3	3.5	1.8	2.0	2.5	2.5	2.0
2.4	3.2	2.3	2.3	3.0	3.9	1.7	3.0	3.9	3.9	2.6	2.4	4.9	2.2	2.6	2.0	2.3	1.8	2.5	4.7	6.8	2.2	2.7	3.3	3.3	2.3
2.8	4.8	2.1	3.0	4.2	7.5	2.1	4.5	7.2	10.0	3.4	3.3	10.0	2.2	3.5	2.4	3.2	2.4	2.8	6.9	10.0	2.8	3.9	6.2	5.7	3.0
4.0	10.0	2.5	4.1	6.8	10.0	2.5	6.5	10.0	10.0	5.0	4.2	10.0	2.6	5.2	2.8	6.8	2.8	3.5	10.0	6.1	3.5	5.8	10.0	10.0	4.1
8.5	5.8	3.4	5.6	10.0	8.9	2.9	10.0	10.0	9.5	6.3	5.0	10.0	3.0	10.0	3.7	3.8	3.9	4.0	10.0	3.1	3.7	10.0	10.0	10.0	6.1
2.3	2.9	2.2	2.6	3.1	3.2	2.3	2.7	3.3	3.2	2.7	2.7	3.8	2.1	2.8	2.8	2.8	2.5	2.7	4.0	4.2	2.2	2.6	3.2	3.2	2.8
2.9	4.1	2.7	3.0	4.4	4.8	2.2	3.8	4.9	4.9	3.3	3.1	6.1	2.8	3.2	3.2	3.0	2.2	3.2	5.6	8.1	2.8	3.5	4.2	4.2	3.0
4.0	5.8	2.5	3.9	5.8	9.2	2.7	5.5	8.8	10.0	4.4	3.6	10.0	2.7	4.3	2.8	4.0	2.7	3.6	8.0	10.0	3.2	5.0	6.5	7.1	3.9
5.6	10.0	3.7	5.4	8.0	10.0	3.2	8.7	10.0	10.0	6.1	4.6	10.0	3.1	7.0	3.5	7.8	3.2	4.5	10.0	8.1	4.3	7.1	10.0	10.0	5.4
10.0	7.1	4.4	7.8	10.0	10.0	3.7	10.0	10.0	10.0	8.5	6.3	10.0	4.4	10.0	5.4	5.0	4.6	5.2	10.0	4.0	5.3	10.0	10.0	10.0	8.4
3.0	3.4	2.5	3.2	3.7	3.9	2.8	3.3	3.9	3.9	3.3	3.2	4.6	2.8	3.4	2.8	3.0	2.7	3.3	4.7	5.0	2.7	3.2	3.9	3.9	3.2
3.6	4.8	3.0	3.7	5.2	5.8	2.7	4.6	5.9	5.9	3.9	3.8	6.6	3.4	4.0	3.4	3.8	3.4	3.8	6.4	8.3	3.3	4.3	5.1	5.1	3.7
4.7	6.9	3.7	4.8	6.7	10.0	3.3	6.6	9.5	10.0	5.3	4.4	10.0	3.3	5.1	4.1	4.8	3.2	4.4	9.1	10.0	3.9	6.1	7.8	8.5	4.8
6.6	10.0	3.7	6.6	9.2	10.0	3.9	10.0	10.0	10.0	7.3	6.4	10.0	4.7	8.4	4.8	9.8	3.7	5.5	10.0	9.7	5.2	9.3	10.0	10.0	7.2
10.0	7.7	4.9	10.0	10.0	10.0	4.5	10.0	10.0	10.0	10.0	10.0	10.0	5.3	10.0	6.4	6.0	6.3	7.1	10.0	4.9	6.4	10.0	10.0	10.0	10.0
3.5	4.1	2.9	3.6	4.2	4.6	3.2	3.9	4.6	4.6	4.0	3.8	5.4	3.3	3.9	3.2	3.5	3.1	3.9	5.4	5.8	3.2	4.8	4.6	4.6	3.8
4.2	5.6	3.5	4.4	5.9	6.8	4.0	5.4	6.1	6.9	4.7	4.5	7.7	4.0	4.6	3.8	4.1	3.8	4.5	7.2	9.4	3.9	5.1	6.0	6.0	4.4
5.8	6.8	3.5	6.7	7.7	10.0	3.9	7.7	10.0	10.0	6.1	6.0	10.0	4.8	6.8	3.9	6.3	3.6	5.1	10.0	10.0	4.8	7.2	9.9	9.8	5.7
7.7	10.0	5.1	8.5	10.0	10.0	4.6	10.0	10.0	10.0	8.4	8.3	10.0	5.4	10.0	5.9	10.0	4.4	6.5	10.0	10.0	6.1	10.0	10.0	10.0	8.8
10.0	8.2	6.4	[illegible]	10.0	10.0	6.1	10.0	10.0	10.0	[illegible]	10.0	[illegible]	6.2	10.0	7.2	[illegible]	[illegible]	8.4	10.0	8.8	7.4	10.0	10.0	10.0	10.0
2.0	2.3	1.7	1.9	2.5	2.8	1.7	2.6	2.8	3.0	2.2	2.0	3.0	1.8	2.2	2.0	2.0	1.8	2.1	3.3	4.1	1.7	2.4	2.6	2.5	2.0
2.4	3.3	2.0	2.7	3.6	3.8	2.2	3.0	3.9	4.4	2.8	2.4	5.5	2.2	2.5	2.4	2.3	2.2	2.4	4.8	7.8	2.1	2.7	3.3	3.8	2.7
3.1	4.7	2.1	3.0	4.8	8.1	2.1	4.4	7.2	10.0	3.4	2.8	10.0	2.7	3.4	3.2	3.8	2.7	2.7	7.7	10.0	2.5	3.8	5.7	5.7	3.0
4.4	10.0	3.1	4.1	6.7	10.0	2.8	7.1	10.0	10.0	4.9	3.6	10.0	2.6	5.6	3.8	7.8	2.7	3.4	10.0	5.4	3.4	6.1	10.0	10.0	4.8
8.5	5.3	3.3	6.0	10.0	8.3	2.9	10.0	10.0	9.3	6.2	4.4	10.0	3.0	10.0	4.7	3.6	3.4	3.9	9.2	2.7	4.1	10.0	10.0	10.0	6.8
2.8	2.9	2.0	2.5	3.1	3.7	2.2	3.3	3.2	3.8	2.8	2.8	3.8	2.3	2.7	2.3	2.5	2.2	2.6	4.0	4.9	2.2	3.1	3.2	3.2	2.8
3.0	4.0	2.8	3.5	4.4	4.8	2.8	3.8	4.9	5.5	3.2	3.1	6.1	2.8	3.2	3.4	3.8	2.7	3.1	5.5	7.8	2.7	3.5	4.2	4.8	3.8
3.9	6.5	3.2	4.4	5.7	9.9	2.7	5.8	8.7	10.0	4.3	3.6	10.0	3.4	4.8	3.5	4.8	2.7	3.5	8.8	10.0	3.2	5.0	7.1	7.1	4.4
8.5	10.0	3.8	5.3	7.9	10.0	3.2	8.6	10.0	10.0	6.0	5.2	10.0	3.3	7.8	4.3	10.0	3.9	4.4	10.0	6.8	4.2	7.8	10.0	10.0	5.9
10.0	6.9	4.8	7.7	10.0	10.0	3.7	10.0	10.0	10.0	8.4	5.6	10.0	3.8	10.0	5.1	4.4	4.4	5.7	10.0	3.5	5.2	10.0	10.0	10.0	8.4
2.9	3.5	2.4	3.1	3.7	4.5	2.7	3.9	3.9	4.8	3.3	3.2	4.8	2.8	3.3	2.6	2.9	2.8	3.2	4.8	5.8	2.7	3.8	3.9	3.9	3.2
3.5	4.8	3.8	4.3	5.1	5.8	3.3	4.8	5.9	6.8	3.9	3.8	7.3	3.4	4.5	3.7	4.2	3.1	3.8	6.3	8.1	3.3	4.3	5.1	5.7	4.3
4.7	7.8	3.8	5.4	6.7	10.0	3.3	6.8	10.0	10.0	5.2	4.4	10.0	4.1	5.9	4.1	5.4	4.0	4.3	10.0	10.0	3.9	6.1	8.5	8.4	5.4
7.3	10.0	4.4	7.2	10.0	10.0	3.9	10.0	10.0	10.0	7.2	6.3	10.0	3.9	9.1	5.1	10.0	4.4	5.4	10.0	8.8	6.1	10.0	10.0	10.0	7.1
10.0	6.4	5.6	10.0	10.0	10.0	5.1	10.0	10.0	10.0	10.0	10.0	10.0	4.5	10.0	6.8	4.9	8.2	8.9	10.0	4.8	6.3	10.0	10.0	10.0	10.0
3.3	4.8	3.6	3.7	4.2	5.3	3.2	4.6	4.8	5.4	3.9	3.8	5.4	3.2	3.9	3.0	4.1	2.9	3.8	5.3	6.7	4.0	4.4	4.6	4.8	3.7
4.8	5.8	3.8	5.1	5.9	8.8	3.8	5.3	8.9	7.6	4.8	4.8	7.6	4.0	4.6	4.5	4.9	4.0	4.5	7.2	10.0	3.9	5.8	6.8	8.7	8.1
8.8	8.8	4.5	6.4	7.8	10.0	3.9	7.8	10.0	10.0	6.1	5.9	10.0	4.7	6.8	4.6	6.4	4.4	5.1	10.0	10.0	5.4	7.2	9.9	10.0	8.4
8.4	10.0	5.4	8.5	10.0	10.0	4.8	10.0	10.0	10.0	9.3	7.4	10.0	4.6	10.0	5.4	10.0	8.8	8.4	10.0	10.0	6.0	10.0	10.0	10.0	8.2
10.0	7.3	6.7	10.0	10.0	10.0	6.0	10.0	10.0	10.0	10.0	10.0	10.0	6.1	10.0	8.2	5.7	7.2	8.2	10.0	5.7	7.3	10.0	10.0	10.0	10.0

2

BLU 27-F				SUU 30			BLU-27 U				SUU-64				A10 TANK				F15 TANK				SUM
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
1.7	2.2	2.2	1.8	1.7	2.2	1.9	1.9	1.5	1.6	1.6	1.8	2.9	3.1	1.9	1.6	2.1	2.1	1.8	1.8	1.8	2.1	1.8	114.3
2.6	3.1	3.5	2.2	2.6	4.0	1.8	2.2	1.4	1.6	2.0	2.2	3.4	4.3	1.8	2.4	2.5	2.8	2.0	2.2	2.3	2.9	2.2	145.8
4.1	5.6	10.0	3.2	2.8	10.0	2.3	2.7	2.4	2.2	2.2	2.6	5.7	9.6	2.1	3.2	4.3	4.2	2.3	2.6	2.7	3.8	2.6	191.6
6.8	10.0	10.0	4.7	10.0	10.0	3.3	4.0	2.7	3.0	[illegible]	2.9	8.9	10.0	2.7	4.4	7.9	8.4	3.5	3.0	3.6	6.7	3.0	248.3
10.0	10.0	10.0	7.8	10.0	10.0	3.8	7.7	2.4	7.1	2.3	3.6	10.0	4.8	3.6	7.1	10.0	10.0	4.6	4.4	4.6	10.0	4.4	286.0
2.2	2.6	2.8	2.3	2.2	2.7	2.4	2.3	1.9	2.0	1.8	2.3	3.4	3.8	2.4	2.1	2.7	2.7	2.1	2.3	2.3	2.7	2.3	135.0
3.4	3.8	4.4	2.8	2.7	4.4	2.4	2.8	2.0	2.6	1.8	2.8	4.1	5.2	2.3	3.1	3.2	3.7	2.6	2.8	2.8	3.7	2.8	169.2
5.1	6.8	10.0	3.9	4.4	10.0	2.9	3.3	2.7	3.2	2.6	3.3	6.6	10.0	2.8	4.1	5.4	5.3	3.6	3.3	3.4	5.3	3.3	221.4
10.0	10.0	10.0	5.7	10.0	10.0	[illegible]	4.9	3.1	3.8	2.9	3.7	10.0	10.0	3.3	5.6	9.7	10.0	4.5	4.4	4.5	8.3	4.4	276.5
10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	3.7	10.0	2.7	4.6	10.0	6.0	4.4	9.5	10.0	10.0	5.9	5.4	5.8	10.0	5.4	318.9
2.7	3.4	3.3	2.8	2.7	3.3	2.8	2.8	2.2	2.4	2.1	2.8	4.0	4.5	2.9	2.6	3.3	3.3	2.6	2.8	2.8	3.3	2.8	158.1
4.1	4.6	5.3	3.4	3.3	5.3	2.8	3.4	2.1	3.0	2.0	3.4	4.8	8.0	2.8	3.8	3.9	4.5	3.2	3.4	3.4	4.5	3.4	198.8
6.1	[illegible]	10.0	4.7	5.3	10.0	4.3	4.0	3.1	3.8	2.9	3.9	7.6	10.0	3.4	5.0	8.4	6.4	4.3	4.0	4.1	6.4	4.0	247.8
10.0	10.0	10.0	6.9	10.0	10.0	4.9	5.9	2.7	4.9	2.6	4.5	10.0	10.0	4.8	6.8	10.0	10.0	6.5	5.3	5.4	8.9	5.3	300.4
10.0	10.0	10.0	10.0	10.0	10.0	6.4	10.0	3.4	10.0	3.3	6.4	10.0	7.8	5.3	10.0	10.0	10.0	7.9	6.5	6.7	10.0	6.5	343.3
4.0	4.0	3.9	3.1	3.2	3.9	3.3	3.3	2.4	2.8	2.3	3.3	4.6	5.2	3.4	3.1	3.9	3.9	3.1	3.3	3.3	3.9	3.3	176.8
4.7	5.4	5.4	4.0	1.9	8.1	3.1	4.0	3.3	1.6	3.2	4.0	5.5	6.9	3.3	4.5	4.6	5.3	3.8	4.0	4.0	5.3	4.0	219.9
7.1	9.4	10.0	[illegible]	6.1	10.0	5.0	5.4	3.8	4.3	3.5	4.6	8.5	10.0	4.0	5.9	7.5	7.5	5.1	4.7	4.7	7.5	4.7	275.6
10.0	10.0	10.0	[illegible]	10.0	10.0	5.7	7.7	4.1	5.7	3.9	5.3	10.0	10.0	5.6	8.0	10.0	10.0	6.5	6.1	6.3	10.0	6.1	324.0
10.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.0	5.2	[illegible]	4.5	[illegible]	10.0	9.1	6.2	10.0	10.0	10.0	9.3	7.6	7.8	10.0	7.6	385.8
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.9	1.8	1.6	1.7	1.6	[illegible]	2.8	3.0	1.8	2.0	2.1	2.1	1.6	1.7	2.3	2.1	1.7	113.7
2.6	3.5	3.5	2.8	2.6	3.9	1.8	2.2	2.4	2.0	2.2	2.1	4.1	5.6	2.3	2.4	2.9	2.9	2.4	2.1	2.7	2.9	2.1	148.5
4.0	6.1	10.0	3.1	3.4	10.0	2.3	3.0	1.9	2.5	1.8	2.5	6.4	10.0	2.7	3.1	4.7	4.7	2.7	3.0	3.1	4.7	3.0	197.0
7.6	10.0	10.0	4.6	4.9	10.0	2.7	4.3	2.7	3.7	2.6	3.3	10.0	9.1	3.1	4.8	9.1	10.0	3.4	3.9	4.1	7.7	3.9	253.8
10.0	10.0	10.0	7.8	10.0	10.0	3.7	10.0	3.7	6.2	2.6	3.9	10.0	4.2	4.0	8.0	10.0	10.0	4.9	4.7	5.6	10.0	4.7	298.2
2.8	2.7	3.3	2.3	2.2	3.3	2.3	2.3	1.8	2.0	1.7	2.2	3.3	3.7	2.3	2.6	2.7	2.7	2.1	2.8	2.9	3.2	2.8	135.8
3.3	4.4	4.4	3.4	3.3	5.6	2.3	2.8	2.7	2.8	2.5	2.7	4.9	6.7	2.9	3.1	3.7	3.7	3.1	3.3	3.4	3.7	3.3	180.1
5.1	7.5	10.0	4.6	3.7	10.0	2.9	3.9	2.5	3.7	2.9	3.2	7.4	10.0	3.4	4.0	5.9	5.9	3.5	3.8	3.9	5.9	3.8	233.5
8.1	10.0	10.0	5.7	6.0	10.0	3.3	5.4	2.9	5.1	2.8	4.1	10.0	10.0	3.9	6.1	10.0	10.0	5.0	4.9	5.0	10.0	4.9	289.4
10.0	10.0	10.0	9.0	10.0	10.0	4.6	10.0	4.6	7.7	3.3	5.0	10.0	5.2	5.0	10.0	10.0	10.0	6.9	6.5	6.7	10.0	6.5	331.5
3.4	3.3	4.0	2.8	2.7	4.0	2.8	2.7	3.0	3.0	2.8	2.7	3.9	4.4	2.8	3.2	3.3	3.3	2.6	3.4	3.4	3.9	3.4	161.6
4.0	5.3	5.3	[illegible]	3.9	5.9	3.5	3.4	3.4	3.0	3.2	3.3	5.6	6.7	3.5	3.8	4.5	4.5	3.6	4.0	4.1	6.1	4.0	205.8
6.0	8.9	10.0	5.4	4.5	10.0	3.4	4.6	2.7	4.2	2.7	3.8	8.4	10.0	4.1	4.9	7.1	7.1	4.3	4.6	4.7	7.1	4.6	260.2
10.0	10.0	10.0	7.6	7.2	10.0	4.9	7.2	4.2	6.1	3.2	5.0	10.0	10.0	4.7	7.4	10.0	10.0	6.1	5.8	6.0	10.0	5.9	318.3
10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.4	8.7	4.7	6.1	10.0	6.3	5.9	10.0	10.0	10.0	8.4	7.7	8.8	10.0	7.7	359.9
4.0	3.9	4.6	3.2	3.2	4.6	3.3	3.3	3.3	3.6	3.1	3.2	4.5	5.1	3.3	3.8	3.8	3.9	3.1	4.0	4.0	4.6	4.0	187.1
4.7	6.1	6.1	4.7	4.6	6.9	[illegible]	4.0	3.6	3.5	3.4	3.9	6.4	7.7	4.1	4.5	5.3	5.3	4.4	4.7	4.8	6.0	4.7	229.7
7.0	10.0	10.0	6.3	5.3	10.0	4.0	5.4	4.0	5.0	3.9	4.5	9.4	10.0	4.8	6.6	8.3	8.3	5.1	5.4	5.5	8.2	5.4	294.5
10.0	10.0	10.0	[illegible]	10.0	10.0	5.6	8.3	4.0	7.9	3.6	5.9	10.0	10.0	5.4	9.5	10.0	10.0	7.1	6.8	7.0	10.0	6.8	343.0
10.0	[illegible]	10.0	10.0	[illegible]	[illegible]	6.3	10.0	5.8	10.0	9.4	[illegible]	10.0	7.4	6.0	10.0	10.0	10.0	10.0	9.8	10.0	10.0	9.9	378.5
2.2	[illegible]	2.8	2.2	2.1	[illegible]	[illegible]	[illegible]	2.4	2.1	[illegible]	[illegible]	1.4	3.5	1.8	2.0	2.5	[illegible]	2.0	2.1	2.2	2.6	2.1	[illegible]
3.1	3.5	3.8	2.6	2.4	4.4	2.3	2.6	1.9	2.4	1.6	2.0	4.0	6.1	2.2	2.7	3.3	3.3	2.3	2.5	2.6	3.3	2.5	159.4
3.9	6.6	10.0	3.5	3.4	10.0	2.2	3.5	3.2	2.8	2.6	2.8	7.0	10.0	2.6	3.5	5.2	5.2	3.1	3.4	3.5	6.1	3.4	211.7
7.3	10.0	10.0	4.4	3.6	10.0	2.7	4.7	3.6	5.0	3.0	3.1	10.0	6.8	3.0	5.2	10.0	10.0	3.8	4.2	4.4	10.0	4.2	260.6
10.0	10.0	10.0	6.6	5.1	10.0	[illegible]	10.0	4.4	4.7	3.0	4.2	10.0	3.6	3.8	10.0	10.0	10.0	[illegible]	6.5	7.4	10.0	6.5	293.7
2.7	3.3	3.3	2.8	2.7	3.2	2.3	2.3	2.7	2.5	2.5	2.2	4.1	4.3	2.3	2.6	3.2	3.2	2.6	2.7	2.8	3.2	2.7	149.8
3.8	4.4	4.9	3.3	3.2	5.5	2.8	3.3	2.2	3.1	2.2	2.6	4.7	7.3	2.8	3.5	4.2	4.2	3.0	3.2	3.3	4.2	3.2	188.3
4.9	8.1	10.0	4.4	4.2	10.0	2.8	4.3	3.4	4.1	3.3	3.6	8.1	10.0	3.3	4.5	6.5	6.5	4.0	4.3	4.4	6.4	4.3	242.8
8.8	10.0	10.0	6.1	8.0	10.0	3.9	6.5	3.8	6.7	3.8	4.0	10.0	9.0	3.8	7.2	10.0	10.0	6.4	6.3	6.8	10.0	6.3	293.6
10.0	10.0	[illegible]	8.8	10.0	10.0	4.5	10.0	8.3	6.8	4.4	7.4	10.0	4.5	4.7	10.0	10.0	10.0	7.8	8.8	10.0	10.0	8.7	334.3
3.3	4.0	3.8	3.3	3.3	4.8	2.8	3.4	3.4	2.9	3.2	2.7	4.7	5.1	2.8	3.2	3.8	3.8	3.8	3.3	3.4	3.8	3.3	177.1
4.6	5.2	5.8	4.0	3.8	6.8	3.4	4.0	2.8	3.6	2.8	3.2	6.5	6.5	3.4	4.3	5.1	5.1	3.7	3.8	4.0	5.7	3.8	218.8
5.9	9.6	10.0	5.3	5.1	10.0	3.4	5.2	3.7	4.8	3.6	4.4	9.2	10.0	4.0	5.5	7.8	7.7	4.9	5.2	5.3	8.4	5.2	274.4
10.0	10.0	10.0	7.4	7.1	10.0	4.0	7.7	4.1	8.8	4.3	5.6	10.0	10.0	4.5	8.7	10.0	10.0	6.6	7.1	7.3	10.0	7.1	319.9
10.0	10.0	10.0	10.0	10.0	10.0	5.4	10.0	5.8	6.7	5.3	6.5	10.0	5.5	5.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	358.0
3.8	4.6	4.6	3.9	3.9	4.8	3.3	3.9	3.7	3.8	3.5	3.2	5.4	5.9	3.3	3.8	4.6	4.6	3.8	3.9	4.0	4.6	3.9	201.5
5.4	6.1	6.9	4.7	4.6	7.7	4.0	4.7	3.2	4.1	3.0	3.8	7.3	8.5	4.0	5.1	6.0	6.0	4.4	4.6	5.8	6.7	4.6	251.6
7.8	10.0	10.0	6.1	6.0	10.0	4.0	6.1	4.0	5.8	3.9	5.2	10.0	10.0	4.7	6.5	9.1	9.0	5.7	6.0	6.2	9.8	6.1	300.2
10.0	10.0	10.0	8.5	8.3	10.0	4.7	9.8	4.6	9.8	4.6	6.6	10.0	10.0	6.2	10.0	10.0	10.0	7.8	8.3	8.8	10.0	8.3	352.8
10.0	[illegible]	10.0	10.0	10.0	[illegible]	6.2	10.0	7.1	7.8	8.2	8.8	10.0	6.5	7.6	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	379.8
[illegible]	2.8	2.8	2.1	2.1	3.0	1.8	2.2	2.4	1.8	2.2	2.1	3.3	3.5	1.8	2.0	2.5	2.5	2.0	2.1	2.7	2.8	2.1	128.8
3.0	3.9	3.9	2.6	2.4	4.9	2.2	2.6	2.0	2.3	1.6	2.5	4.7	6.8	2.2	2.7	3.3	3.3	2.3	3.0	3.1	3.7	3.0	169.4
4.5	7.2	10.0	3.4	3.3	10.0	2.7	3.5	2.4	3.2	2.4	2.8	6.9	10.0	2.6	3.9	6.2	5.7	3.0	3.3	4.0	5.8	3.3	207.1
6.5	10.0	10.0	5.0	4.2	10.0	2.8	5.2	2.8	6.6	2.8	3.5	10.0	6.1	3.5	5.6	10.0	10.0	4.1	4.6	6.6	10.0	4.6	259.5
10.0	10.0	9.5	6.3	5.0	10.0	3.0	10.0	3.7	3.8	3.9	4.0	10.0	3.1	3.7	10.0	10.0	10.0	6.1	9.5	10.0	7.8	9.0	291.1
2.7	3.3	3.2	2.7	2.7	3.8	2.1	2.8	2.6	2.8	2.5	2.7	4.0	4.2	2.2	2.6	3.2	3.2	2.6	2.7	3.4	3.7	2.7	188.3
3.8	4.9	4.9	3.3	3.1	6.1	2.8	3.2	3.2	3.0	2.2	3.2	5.6	8.1	2.8	3.5	4.2	4.2	3.0	3.6	3.8	4.7	3.8	198.1
5.8	6.8	10.0	4.4	3.6	10.0	2.7	4.3	2.8	4.0	2.7	3.6	8.0	10.0	3.2	5.0	6.5	7.1	3.9	4.8	5.0	7.0	4.6	240.8
8.7	10.0	10.0	6.1	4.6	10.0	3.3	7.0	3.5	7.8	3.2	4.5	10.0	8.1	4.3	7.1	10.0	10.0	5.4	6.4	6.7	10.0	6.4	290.9
10.0	10.0	10.0	6.5	6.3	10.0	4.4	10.0	5.4	5.0	4.6	5.2	10.0	4.0	5.3	10.0	10.0	10.0	8.4	10.0	10.0	9.2	10.0	322.3
3.3	3.9	3.9	3.3	3.2	4.8	2.8	3.3	2.8	3.0	2.7	3.3	4.7	5.0	2.7	3.2	3.9	3.9	3.2	4.0	4.1	4.8	4.0	188.6
4.6	5.9	5.9	3.9	3.8	6.6	3.4	4.0	3.4	3.6	3.4	3.8	6.4	8.3	3.3	4.3	5.1	5.1	3.7	4.6	4.7	6.7	4.6	223.2
6.6	9.5	10.0	5.3	4.4	10.0	3.3	5.1	4.1	4.8	3.2	4.4	9.1	10.0	3.9	6.1	7.8	8.5	4.8	5.8	6.0	9.1	5.8	272.1
10.0	10.0	10.0	7.3	6.4	10.0	4.7	8.4	4.8	9.9	3.7	5.5	10.0	9.7	5.2	9.3	10.0	10.0	7.2	7.7	8.7	10.0	7.7	328.1
10.0	10.0	10.0	10.0	10.0	10.0	5.3	10.0	6.4	6.0	6.3	7.1	10.0	4.9	6.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	356.7
3.9	4.6	4.6	4.0	3.8	5.4	3.3	3.9	3.2	3.8	3.1	3.9	5.4	5.8	3.2	4.5	4.8	4.8	3.8	4.6	4.7	5.3	4.7	205.6
5.4	6.1	6.9	4.7	4.6	7.7	4.0	4.6	3.9	4.1	3.8	4.5	7.2	9.4	3.9	5.1	6.0	6.0	4.4	5.3	5.4	6.7	5.3	250.3
7.7	10.0	10.0	6.1	6.0	10.0	4.8	6.8	3.9	6.3	3.6	5.1	10.0	10.0	4.6	7.2	9.9	9.8	5.7	6.8	6.9	10.0	6.8	306.6
10.0	10.0	10.0	8.4	8.3	10.0	5.4	10.0	5.9	10.0	4.4	6.5	10.0	10.0	6.1	10.0	10.0	10.0	8.5	9.8	10.0	10.0	9.6	358.9
10.0	10.0	10.0	[illegible]	10.0	10.0	6.2	10.0	7.2	8.8	8.8	8.4	10.0	5.8	7.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	370.3
2.6	2.8	3.0	2.2	2.0	3.0	1.8	2.2	2.0	2.8	1.8	2.1	3.3	4.1	1.7	2.4	2.8	2.5	2.0	2.5	2.6	2.8	2.8	128.4
3.0	3.9	4.4	2.6	2.4	5.5	2.2	2.5	2.4	2.3	2.2	2.4	4.6	7.5	2.1	2.7	3.3	3.8	2.7	2.9	3.0	3.7	2.9	165.0
4.4	7.2	10.0	3.4	2.8	10.0	2.7	3.4	3.2	3.8	2.7	2.7	7.7	10.0	2.5	3.8	5.7	5.7	3.0	3.8	3.9	6.1	3.8	211.8
7.1	10.0	10.0	4.9	3.6	10.0	2.6	5.6	3.8	7.8	2.7	3.4	10.0	5.4	3.4	6.1	10.0	10.0	4.6	5.5	5.8	10.0	5.6	263.8
[illegible]	10.0	9.3	6.2	4.4	10.0	3.0	10.0	4.7	3.8	3.4	3.9	9.2	2.7	4.1	10.0	10.0	10.0	6.9	5.9	5.4	8.9	6.3	269.7
[illegible]	3.2	3.8	2.8	2.8	3.8	2.3	2.7	2.3	2.5	2.2	2.6	4.0	4.9	2.2	3.1	3.2	3.2	2.8	3.2	3.3	3.7	3.2	152.6
[illegible]	4.9	6.5	3.2	3.1	6.1	2.8	3.2	3.4	3.8	2.7	3.1	5.5	7.8	2.7	3.5	4.2	4.8	3.5	3.7	3.8	6.3	3.7	198.7
[illegible]	6.7	10.0	4.3	3.6	10.0	3.4	4.8	3.8	4.8	2.7	3.5	8.8	10.0	3.2	5.0	7.1	7.1	4.4	4.7	5.8	7.8	4.7	248.0
[illegible]	10.0	10.0	6.0	5.2	10.0	3.3	7.8	4.3	10.0	3.9	4.4	10.0	6.6	4.2	7.8	10.0	10.0	6.9	6.9	7.9	10.0	6.9	298.8
[illegible]	10.0	10.0	6.4	5.6	10.0	3.8	10.0	5.1	4.4	4.4	6.7	10.0	3.5	5.2	10.0	10.0	10.0	9.4	6.4	6.2	7.8	6.8	301.8
[illegible]	3.9	4.8	3.3	3.2	4.8	2.8	3.3	2.8	2.8	2.6	3.2	4.8	5.8	2.7	3.8	3.9	3.9	3.2	3.9	4.0	4.5	3.9	178.8
4.8	5.9	6.8	3.8	3.8	7.3	3.4	4.5	3.7	4.2	3.1	3.8	6.3	9.1	3.3	4.3	5.1	5.7	4.3	4.5	5.3	6.4	4.5	226.1
[illegible]	10.0	10.0	5.2	4.4	10.0	4.1	5.8	4.1	6.4	4.0	4.3	10.0	10.0	3.8	6.1	8.5	8.4	5.4	6.4	6.8	9.8	6.4	280.8
[illegible]	10.0	10.0	7.2	6.3	10.0	3.9	9.1	5.1	10.0	4.4	5.4	10.0	8.8	6.1	10.0	10.0	10.0	7.1	9.0	10.0	10.0	9.0	328.2
[illegible]	10.0	10.0	10.0	10.0	10.0	4.5	10.0	6.8	4.8	6.2	6.9	10.0	4.8	6.3	10.0	10.0	10.0	10.0	7.1	8.8	8.8	7.2	330.0
[illegible]	4.6	5.4	3.8	3.8	5.4	3.2	3.9	3.0	4.1	2.8	3.8	5.3	6.7	4.0	4.4	4.6	4.6	3.7	4.6	4.7	5.3	4.8	206.4
[illegible]	6.9	7.6	4.6	4.6	7.8	4.0	4.6	4.5	4.8	4.0	4.5	7.2	10.0	3.8	5.8	6.8	6.7	5.1	6.1	6.2	7.5	6.1	268.8
[illegible]	10.0	10.0	6.1	5.9	10.0	4.7	6.8	4.6	6.4	4.4	8.1	10.0	10.0	8.4	7.2	9.9	10.0	8.4	7.8	7.7	10.0	7.8	313.4
[illegible]	10.0	10.0	9.3	7.4	10.0	4.6	10.0	5.4	10.0	5.8	8.4	10.0	10.0	8.0	10.0	10.0	10.0	8.2	10.0	10.0	10.0	10.0	360.5
[illegible]	10.0	10.0	10.0	10.0	10.0	8.1	10.0	8.2	5.7	7.8	8.2	10.0	5.7	7.3	10.0	10.0	10.0	10.0	7.7	7.3	8.8	[illegible]	348.0

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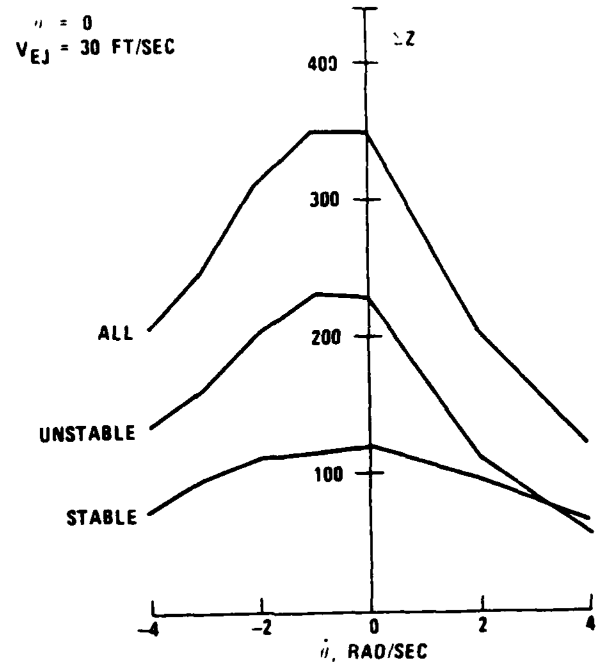
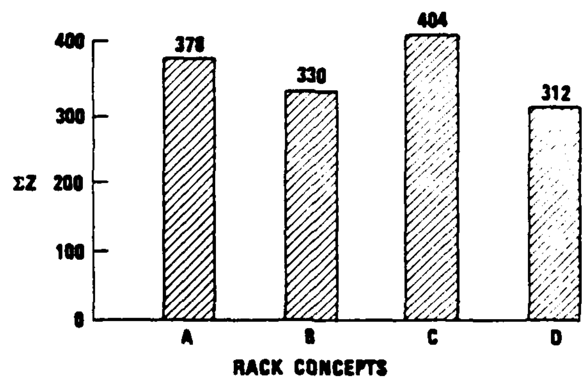


FIGURE 11. General Effect of Store Pitch Rate.



A = ONE FIXED EOE SETTING (30 FT/SEC, −4 DEG, 0 RAD/SEC)
B = ONE FIXED EOE SETTING (25 FT/SEC, 0 DEG, 0 RAD/SEC)
C = SELECTION OF BEST EOE SETTING FROM FOUR POSSIBILITIES
(30, 0 DEG, 0), (30, −4 DEG, 0), (30, +4 DEG, 0), (30, 0 DEG, −2)
D = EOE SETTING WHICH IS A FUNCTION OF STORE WEIGHT
(0 → 350 LB = 30, 0 DEG, 0), (351 → 750 LB = 25, 0 DEG, 0),
(751 → 1250 LB = 20, 0 DEG, 0), (1250 → 3000 LB = 15, 0 DEG, 0)

FIGURE 12. Rack Scoring.

PHASE III

The data presented thus far evaluate changes in store motion caused by varying the EOE values for a fixed set of carriage loads. A much smaller study was completed in which the EOE values were fixed and the carriage loads were systematically varied. The results from this study are an envelope of store loads that produce acceptable trajectories for the selected store and EOE values. Figure 13 shows how these envelopes change with different EOE values for a stable store and Figure 14 provides for an unstable store. The difference in the response of stable and unstable stores to captive loads and ejection parameters is dramatically illustrated by the two figures. For stable stores, acceptable trajectories are produced for all values of C_{M_I}, below a maximum value. The acceptable envelope for unstable stores tends to be a narrow wedge which decreases in size as the carriage normal force increases. Selecting appropriate end-of-stroke values to achieve acceptable separation of unstable stores is obviously much more difficult.

Generating the acceptable envelopes is a tedious process that requires a large number of computer runs, but the data could be input to an onboard computer for inflight determination of safe weapon release conditions. Inflight measurements of carriage loads could be compared with these envelopes. The comparisons could be used either to identify safe release conditions for known EOE values or, for a variable ejector rack, select appropriate EOE values.

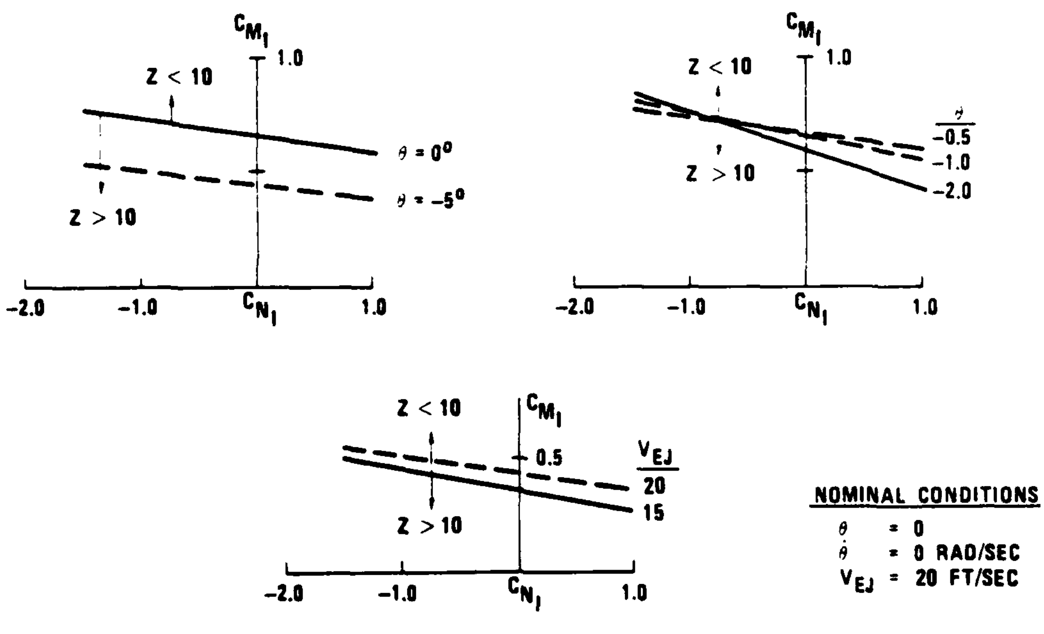


FIGURE 13. Acceptable Envelope for SUU-30 (Stable).

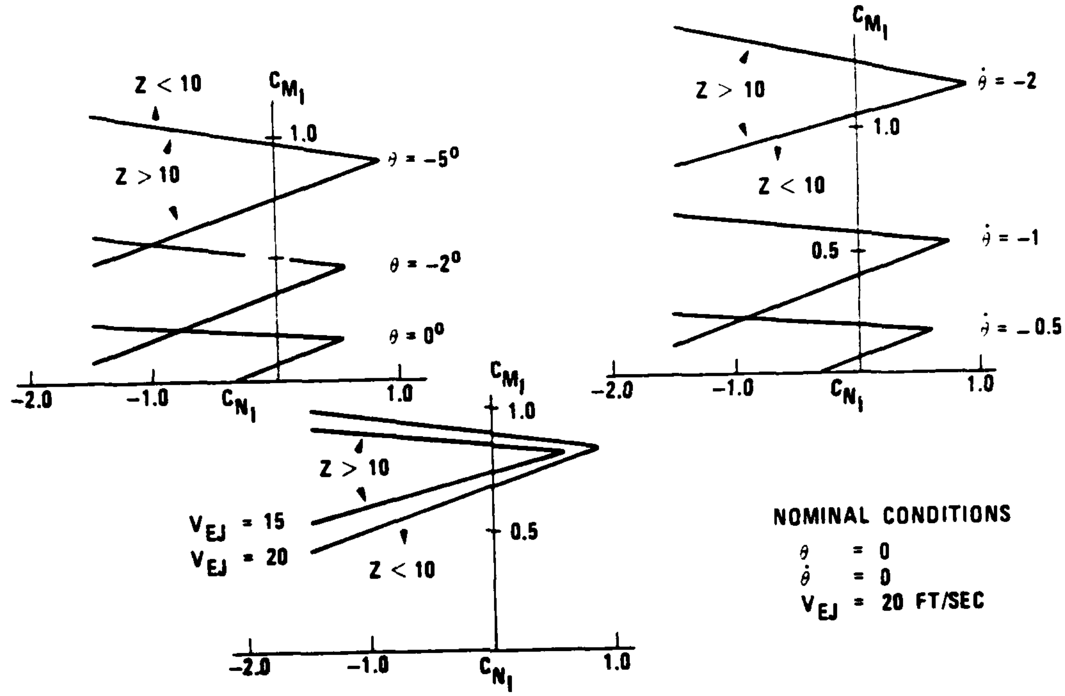


FIGURE 14. Acceptable Envelope for BLU-27 (Unstable).

SUMMARY

This study has attempted to identify the EOE requirements for a new, general-purpose bomb rack that must accommodate many different stores, aircraft, and release conditions. It was necessary to assume that the new rack designs could achieve specified EOE values independent of the applied aerodynamic store loads, or that these loads would be measured in flight and EOE values adjusted accordingly. Although a system with these capabilities does not currently exist, developments in rack design and stores management systems make it possible in the near future.

The large number of captive loads acquired for this study encompass a wide range of aircraft angles of attack and Mach numbers. Some of the maximum loads used may occur at flight conditions outside existing aircraft capabilities or, even more likely, may not be representative of loads corresponding to current weapon delivery maneuvers. Using these extreme loads allows for the inevitable growth in aircraft performance that will occur in the service life of a rack that is only in the conceptual design stages. Also, a rack capable of accommodating these maximum loads should work equally as well for smaller store loads.

The acceptable envelopes shown in Figure 14 for the unstable BLU-27 illustrate the importance of both the normal force and pitching moment in achieving safe

separation. As the normal force becomes more positive, the range of positive pitching moments which will produce acceptable separation is quickly reduced in magnitude. Figure 13 indicated the same is not true for the stable SUU-30 store. Comparisons of the equivalent envelopes for the stable and unstable stores, Figure 13 and 14 respectively, graphically show that safe separation can be achieved over a much wider range of captive loads with a stable store configuration.

Trends resulting from changing the individual EOE parameters are evident for specific stores by examining the detailed results from Table 3. Acceptable EOE parameters for lightweight, unstable stores are often restricted to very specific values, with the store motion being greatly affected by small changes in EOE pitch rate and attitude. This trend is also evident in Figure 14. Changing θ and $\dot{\theta}$ does not significantly increase the size of the acceptable envelope; it just shifts the magnitude of the loads which can be accommodated by specific EOE parameters. For both stable and unstable stores, the size of the acceptable loads envelope is increased by using higher ejection velocities.

When emphasis is placed on the ability of EOE parameters to acceptably separate a wide variety of stores, the trends shown in Figures 9, 10, and 11 are appropriate and the results for specific EOE values are summed in the right-hand column of Table 4. These data indicate that best overall results are obtained with high ejection velocities, pitch rates near zero or slightly negative, and pitch angles between -2 and -4 degrees.

Appendix A

INDEPENDENT EJECTION ANALYSIS

BACKGROUND

One of the major goals of the EOE study was to develop an objective technique for evaluating ejector design concepts. Existing ejectors (independent, hot gas types) do not deliver constant EOE conditions, since they respond to aerodynamic loads during ejection. For this reason, they cannot be directly evaluated using the EOE matrix in Table 4.

DISCUSSION

To evaluate independent ejections requires an intermediate calculation to determine what EOE exists after ejection, for each aerodynamic load/store combination. A computer model was used to calculate velocity, pitch angle, and pitch rate for each of the 44 aerodynamic loads. The model assumed a high performance design, capable of exerting a constant 10,000 lbf at each ejector. The forces were applied through the bomb lug locations. Stroke lengths were not specified in order to allow each case to reach 30 ft/sec velocity. Pitch angle and rate were recorded as the store passed 15, 20, 25, and 30 ft/sec, for a total of 176 EOE conditions. The EOE values for a particular aerodynamic load were then matched, as closely as possible, with those in Table 4. The Z values associated with these matched EOE conditions were then summed for each velocity, using interpolation when necessary.

RESULTS

The sum of the Z values for an independent ejector design are shown in Table A-1 for various end-of-stroke velocities. Results obtained for the dependent ejector

using equivalent EOE velocities with zero store pitch attitude and pitch rate are also shown. Differences between the independent and dependent values result from store pitch rotation during ejection. The larger differences found at the higher ejection velocities result from the long ejection time required, thus allowing the store to reach higher pitch angles and rates at EOE.

TABLE A-1. Rack Comparison

Velocity, ft/sec	ΣZ	
	Independent	Dependent
15	260	270
20	279	300
25	277	330
30	290	348

CONCLUSION

Higher ejection velocities can improve store separation trajectories, but much of this improvement can be lost if store pitch attitude and rate are not also controlled.

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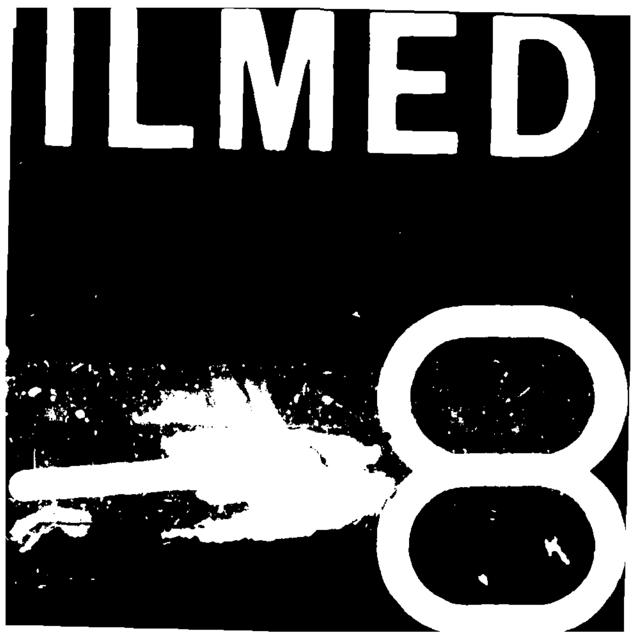
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